VNIVERSITAT DE VALÈNCIA Facultat de Magisteri

Natural sciences for schoolteachers
LESSON 7:
The human body and health

Contents

1. Health and health promotion.
2. The human body: nutrition.
3. The human body: response.
4. The human body: reproduction.

Health and health promotion

Health

According to the **World Health Organization** (WHO),

"health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

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Health and health promotion

Health

The main **determinants of health** are:

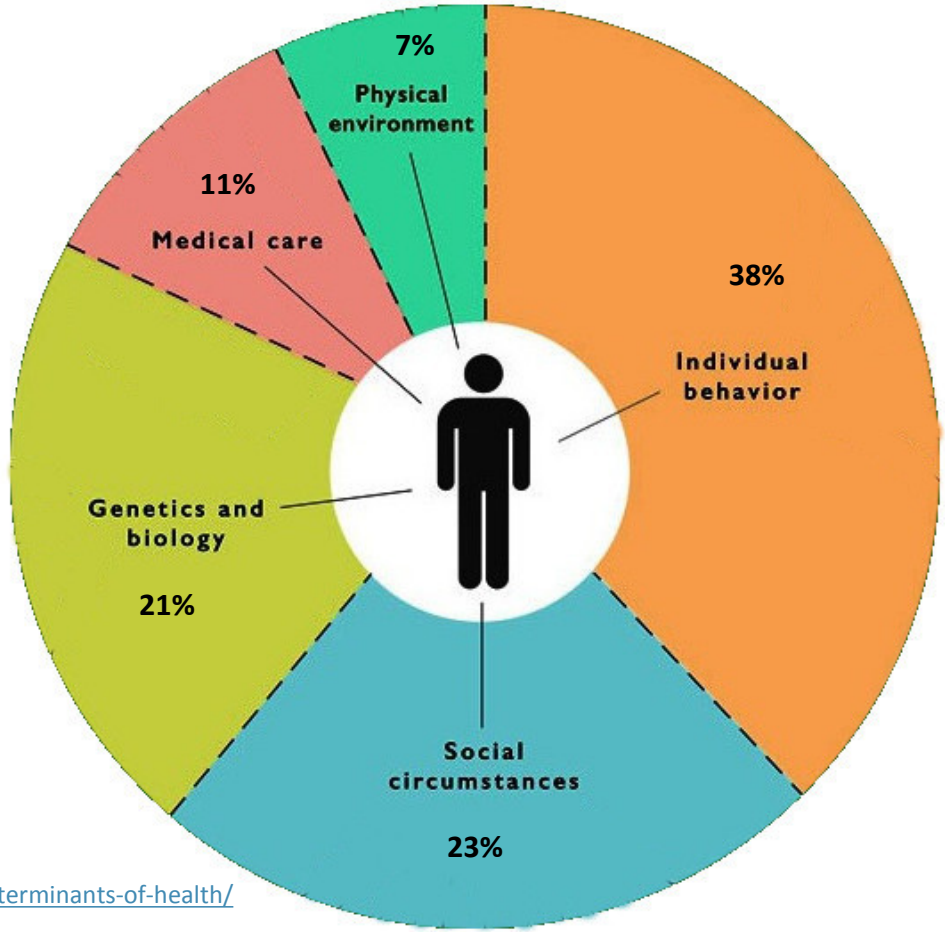

Image: Jsonin / A.R. Esteve
http://www.goinvo.com/features/determinants-of-health/
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Health and health promotion

Health

The main **determinants of health** are:

- **Individual behavior**, which involves a person's health practices (*e.g., balanced diet, physical activity, coping skills, risk behavior*).
- **Social and economic circumstances**, which determine the quality, access and use of health services (*e.g., poverty, education*).
- **Genetics and biology**, which determine the characteristics of the organism (*e.g., genetic inheritance, age*).
- **Medical care**, which is responsible for health promotion, preventing and treating diseases (*e.g., medicine, pharmacy, psychology*).
- **Physical environment**, which involves the characteristics of the natural, built and social environments (*e.g., safe water, clean air, adequate housing*).

Health and health promotion

Diseases

A **disease** is any condition that impairs the normal functioning of the body.

Depending on the causes of the disease, they can be classified as:

- **Infectious diseases**, which are caused by a ***pathogen*** (bacteria, viruses, fungi, etc.) that invade an organism's body. Most of these diseases can be transmitted from one individual to another.

- **Non-infectious diseases**, which are not caused by infectious agents (accidents, aging, etc.). Most of these diseases can not be transmitted from one individual to another.

Health and health promotion

Diseases: non-infectious diseases

NON-INFECTIOUS DISEASES	
genetic	*hemophilia, color blindness, Down syndrome, achondroplasia*
congenital	*spina bifida, cleft lip*
degenerative	*Alzheimer's, Parkinson's, arteriosclerosis*
nutritional	*obesity, malnutrition, scurvy*
endocrine and metabolic	*diabetes, albinism*
autoimmune	*rheumatoid arthritis, coeliac disease, psoriasis, multiple sclerosis, lupus*
mental	*depression, anxiety, schizophrenia, anorexia, bulimia*
allergic	*pollen, mites*
toxicological	*snake or spider bites, food poisoning*
peer pressure	*alcoholism, drug addiction*
occupational	*low back pain, carpal tunnel syndrome, allergic alveolitis, pneumoconiosis*
accidents	*dislocations, fractures*

Health and health promotion

Diseases: non-infectious diseases

- ✓ **Genetic disorders**, due to changes in an individual's DNA that have been passed down from the parents or caused by new mutations (*e.g., hemophilia, color blindness, Down syndrome, achondroplasia*).
- ✓ **Congenital disorder**, which are present from birth and may result from malformations during the development of the embryo/fetus or from genetic factors (*e.g., spina bifida, cleft lip*).
- ✓ **Degenerative diseases**, caused by the deterioration of tissues/organs (*e.g., Alzheimer's, Parkinson's, arteriosclerosis*).
- ✓ **Nutritional diseases**, caused by an inadequate diet (*e.g., obesity, malnutrition, scurvy*).
- ✓ **Endocrine diseases and metabolic disorders**, caused by the secretion of a hormone in deficiency or excess (*e.g., diabetes, albinism*).
- ✓ **Autoimmune diseases**, due to an abnormal response of the immune system, attacking healthy cells of the body (*e.g., rheumatoid arthritis, coeliac disease, psoriasis, multiple sclerosis, lupus*).

Health and health promotion

Diseases: non-infectious diseases

- ✓ **Mental disorders**, which include a wide variety of disorders, are the result of the complex interaction between biological, social and psychological factors (*e.g., depression, anxiety, schizophrenia, anorexia, bulimia*).
- ✓ **Allergic diseases**, caused by hypersensitivity of the immune system to typically harmless substances in the environment (*e.g., pollen, mites*).
- ✓ **Toxicological diseases**, caused by the presence of toxins inside the individual's body (*e.g., snake or spider bites, food poisoning*).
- ✓ **Social diseases**, directly related to social and economic factors (*e.g., alcoholism, drug addiction*).
- ✓ **Occupational diseases**, which occur as a result of work or occupational activity (*e.g., low back pain, carpal tunnel syndrome, allergic alveolitis, pneumoconiosis*).
- ✓ **Accidents** (*e.g., dislocations, fractures*).

Health and health promotion

Diseases: infectious diseases

Infectious diseases are caused by the invasion of an individual's body by ***pathogens*** (bacteria, viruses, fungi, etc.) and their multiplication.

The **stages** of an infectious disease are:

- **exposure:** the pathogen enters the individual's body.
- **incubation period:** the pathogen multiplies and invades the individual's body. There are no symptoms of the disease. The duration of this period depends on the disease.
- **disease:** The disease runs its course showing several symptoms (*e.g., fever, rashes, etc.*).
- **convalescence:** health is gradually recovered after the disease.

Health and health promotion

Diseases: infectious diseases

The main **pathogens** are:

Bacteria

Mycobacterium tuberculosis

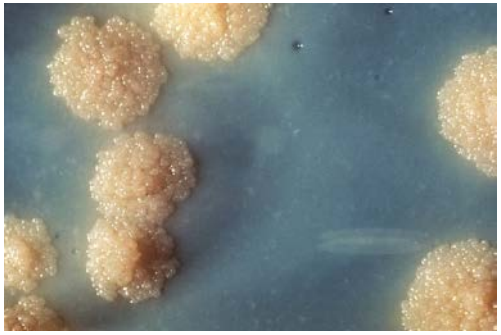


Image: Dr. George Kubica
US CDC

Viruses

Filovirus Ebolavirus

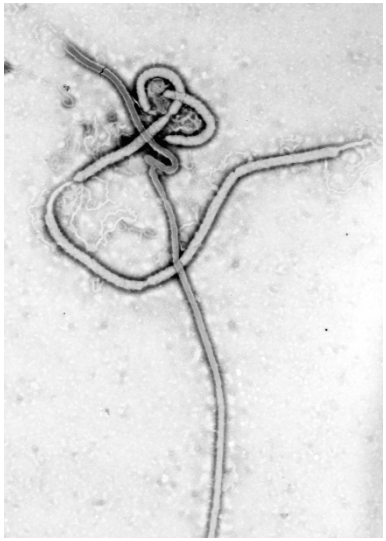


Image: Dr. Frederick A. Murphy
US CDC

Fungi

Candida albicans

Image: Dr. William Kaplan
US CDC

Health and health promotion

Diseases: infectious diseases

The main **pathogens** are:

- **Bacteria:** simple prokaryotes which are present in the air, water or inside other organisms. Although most are harmless, some can cause infectious diseases (*e.g., tuberculosis, pneumonia, tetanus, cholera, salmonellosis*). Most bacterial infections can be treated with ***antibiotics***.
- **Viruses:** small infectious agents that replicate only inside the living cells of other organisms. They cause infectious diseases, which are contagious, that can not be treated with antibiotics (*e.g., cold, flu, chicken pox, Ebola, AIDS*). Viral infections are treated with ***vaccines***, ***antibodies*** or ***antivirals***.
- **Fungi:** heterotrophic eukaryotes which usually can be found in the hair, nails, and skin (*e.g., candidiasis, athlete's foot, ringworm*). Fungal infections are treated with ***antifungals***.

Other pathogens may cause infections as well, such as **protozoa** (*e.g., malaria*) and **prions** (*e.g., bovine spongiform encephalopathy*).

Diseases: infectious diseases

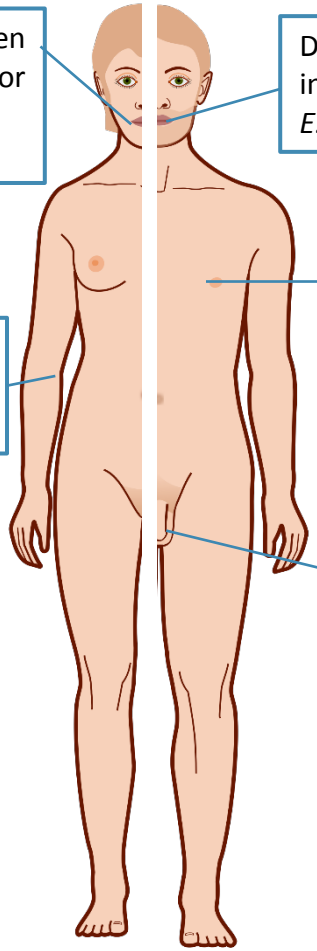
Most infectious diseases are **contagious**.

Eating **food** that has been poorly handled, prepared or stored.
E.g.: botulism, salmonellosis

Drinking and using infected **water**.
E.g.: dysentery, cholera

Transmission of pathogens from infected organisms or the environment through the **air** (in dust particles or drops of moisture).
E.g.: cold, flu, measles, tuberculosis, pneumonia

Entry of microorganisms through skin **wounds**.
E.g.: rabies, tetanus, gangrene



Sexually transmitted diseases (STDs).
E.g.: gonorrhea, hepatitis B, genital herpes, syphilis, AIDS

Bites from animals or eating food infected by **animals** (mosquitoes, flies, ticks, lice or fleas).
E.g.: yellow fever, plague, malaria

Image: Vsion / Sjef / Racconish

Health and health promotion

Human body defences

The human body has several mechanisms to prevent and fight infections:

- **Physical barriers**, which prevent the entry of pathogens into the body. They are the ***skin***, ***mucous membranes*** (*e.g., mouth, nose, stomach, vagina*) and ***secretions*** (*e.g., tears, saliva, sweat*).
- **Innate immune system**, which is the body's response to infection independently of the pathogen. It includes ***leukocytes*** (basophils, phagocytes, etc.), ***inflammation*** (caused by increased blood flow in the infected area), ***fever*** (which stimulates the body's immune system), and the ***complement system*** (blood proteins that help the immune system to attack pathogens).
- **Adaptive immune system**, which is highly specific to a particular pathogen and creates immunological memory after an initial response to it. It consists of ***lymphocytes***, which make specific ***antibodies*** that attack a specific pathogen.

Health and health promotion

The immune system

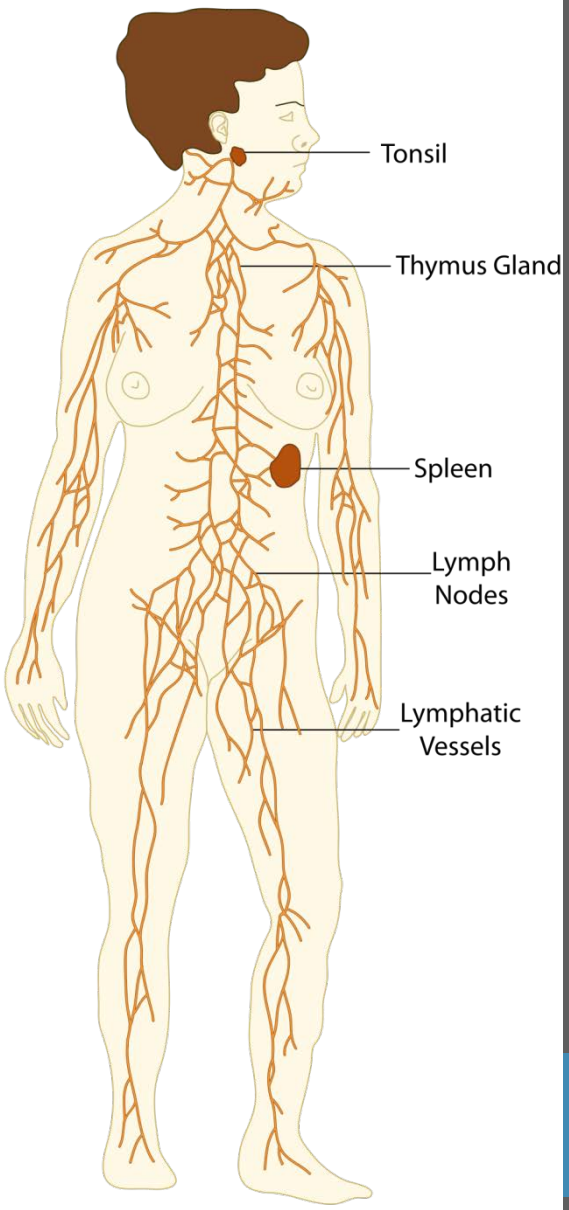
The **immune system** consists of several organs and tissues which produce and store ***lymphocytes***.

Lymphocytes are produced in the **bone marrow** and are transported by the **lymphatic vessels** to different organs (**thymus**, **spleen**, and **lymph nodes**).

The lymphocytes mature and differentiate into ***B cells*** (**bone marrow**) and ***T cells*** (**thymus**).

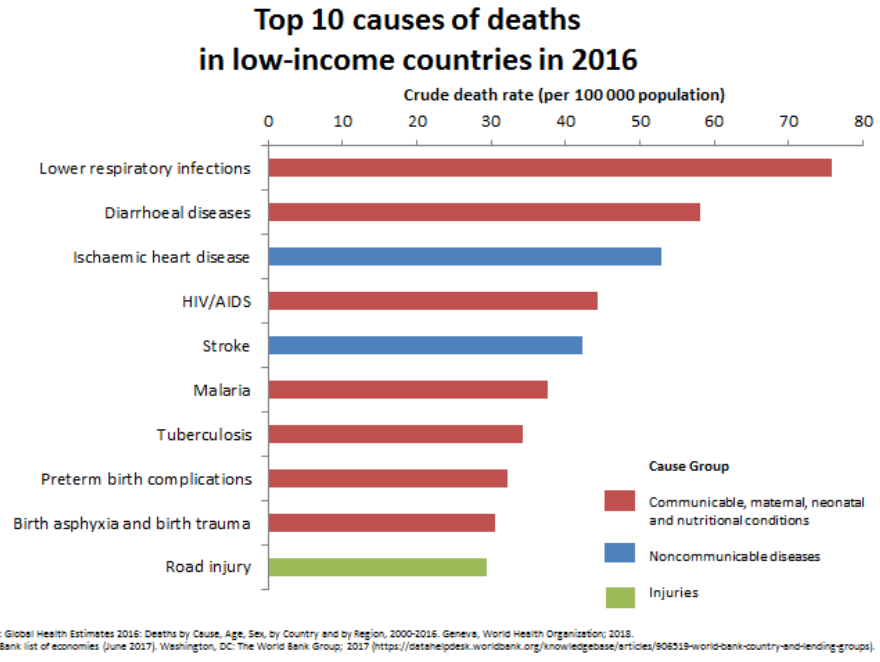
In the **lymph nodes** (axillary, inguinal, neck, etc.), lymphocytes come into contact with pathogens, activating and fighting the infection.

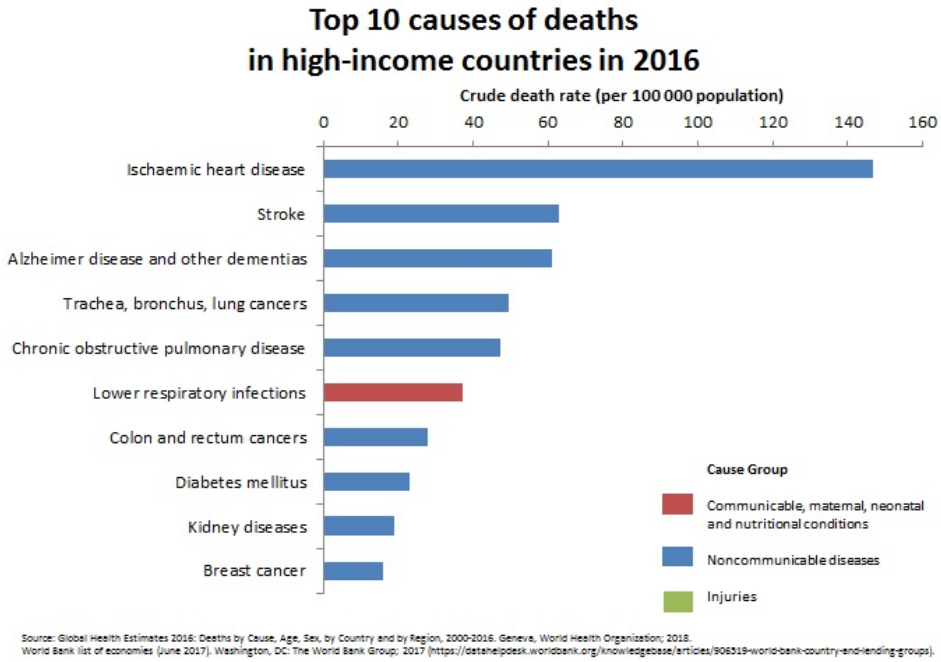
The **spleen** filters and cleans the blood.



Health and health promotion

Disease prevention





Images: WHO
http://www.who.int

Health and health promotion

Disease prevention

Many diseases can be prevented through:

- **Health administration**, which manages healthcare systems, hospitals, etc.
- **Preventive medicine**, which consists of the necessary measures taken for disease prevention (*e.g., vaccination, periodic check-ups, anti-smoking campaigns, etc.*)
- **Healthy lifestyle**, which allows to prevent some diseases (*e.g., eat a healthy diet, maintain good personal hygiene, exercise, avoid smoking, etc.*)
- **Health promotion**, which enables people to increase control over their own health. It covers a wide range of social and environmental interventions that are designed to benefit and protect individual people's health and quality of life by addressing and preventing the root causes of ill health, not just focusing on treatment and cure.

#CHOOSEHEALTH

1 EAT A HEALTHY DIET

2 BE PHYSICALLY ACTIVE, EVERY DAY, YOUR WAY

3 GET VACCINATED

4 DON'T USE ANY FORM OF TOBACCO

5 AVOID OR MINIMIZE USE OF ALCOHOL

6 MANAGE STRESS FOR YOUR PHYSICAL AND MENTAL HEALTH

7 PRACTICE GOOD HYGIENE

8 DON'T SPEED, OR DRINK AND DRIVE

9 WEAR A SEAT-BELT WHEN DRIVING AND HELMET WHEN CYCLING

10 PRACTICE SAFE SEX

11 REGULARLY CHECK YOUR HEALTH

12 BREAST FEEDING: BEST FOR BABIES

World Health Organization

WWW.WHO.INT/SHANGHAI2016

9th Global Conference on Health Promotion
SHANGHAI 2016

#CHOOSEHEALTH

World Health Organization

WWW.WHO.INT/SHANGHAI2016

9th Global Conference on Health Promotion
SHANGHAI 2016

The human body: nutrition

All living beings need substances from their environment (***nutrients***) to obtain the matter and energy they need to live.

Image: Rhoda Baer
National Cancer Institute

Nutrition is the process by which organisms acquire and process the food and fluids that are necessary to support their life and health.

The human body: nutrition

In human nutrition, the following systems participate:

- The **digestive system** transforms the ***food*** so it can be absorbed and used by the body's cells (***digestion***).
- The **respiratory system** supplies ***oxygen*** (O_2) to the blood so it can be used by the cells to obtain energy. It also releases the ***carbon dioxide*** (CO_2) produced by the body (***respiration***).
- The **circulatory system,** which transports substances (*e.g., red blood cells, leukocytes, platelets, hormones, gases, etc.*) throughout the body, transports nutrients to the cells of the body and waste products that need to be eliminated from those same cells.
- The **excretory system** removes the waste products that the circulatory system transports.

The human body: nutrition

Digestive system

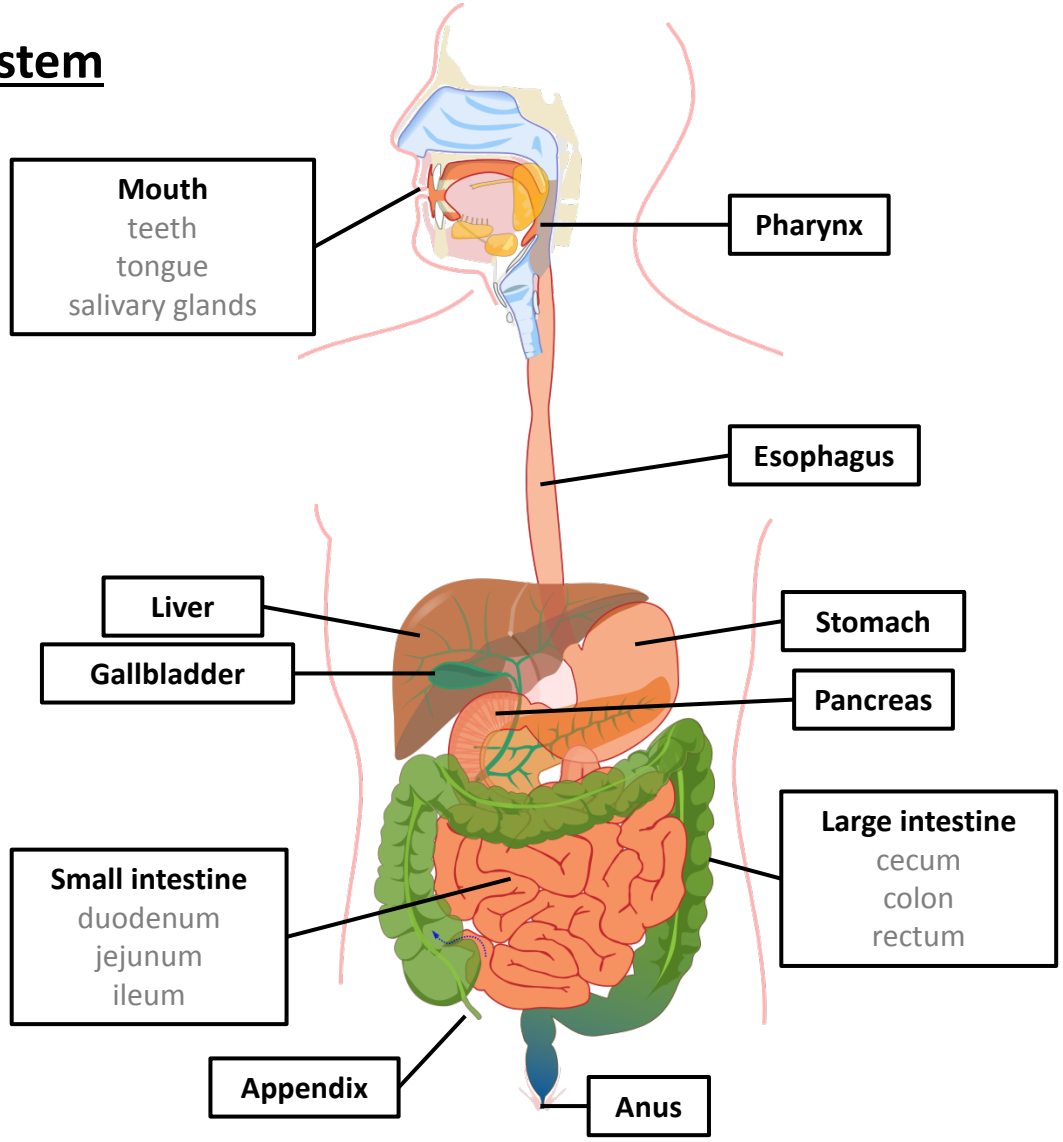


Image: LadyofHats

The human body: nutrition

Digestive system

The **mouth** is the part of the digestive system that receives the food. In the mouth, the **teeth** chew the food and the **tongue** mixes it with **saliva**, forming the ***bolus***.

The bolus is swallowed down into the **pharynx** and the **esophagus**. In the pharynx, the ***epiglottis*** closes to prevent food from going into the respiratory tract.

Once in the esophagus, the bolus travels down to the **stomach** via rhythmic contraction and relaxation of the muscle tissue of the esophagus (***peristalsis***).

Image: pixabay.com

The human body: nutrition

Digestive system

The **stomach** is the organ in which food is stored and processed. It has several gastric glands which release ***gastric juices*** (hydrochloric acid, enzymes and mucus).

After some time in the stomach, the bolus, which has mixed with the digestive enzymes, is partially digested. This results in a thick liquid substance called ***chyme***.

The chyme passes through to the **intestine**, where digestion continues.

Image: www.MedicalGraphics.de
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The human body: nutrition

Digestive system

The **pancreas** is a gland that secretes ***pancreatic juice*** (enzymes and bicarbonate), which is released into the intestine to help to further digest the chyme.

Image: www.MedicalGraphics.de
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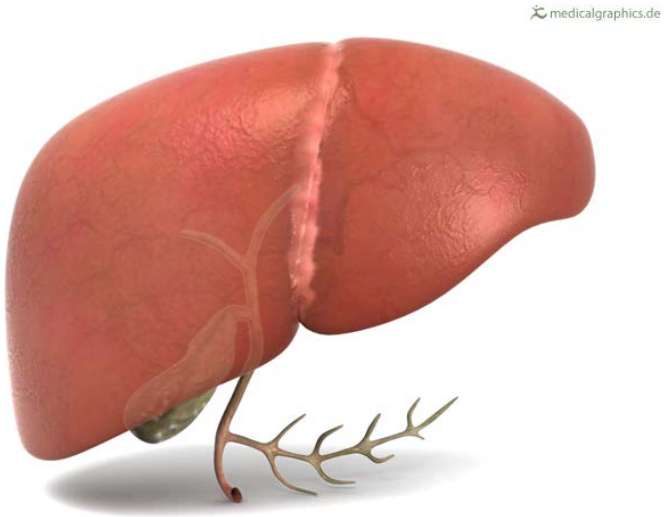
The pancreas also secretes ***hormones*** such as ***insulin*** that are released directly into the blood and regulate the metabolism of glucose.

The human body: nutrition

Digestive system

The **liver** is an organ that produces a substance called ***bile***, which is essential for the digestion of fats. It is also responsible for eliminating toxic substances (*e.g., alcohol*) from the blood.



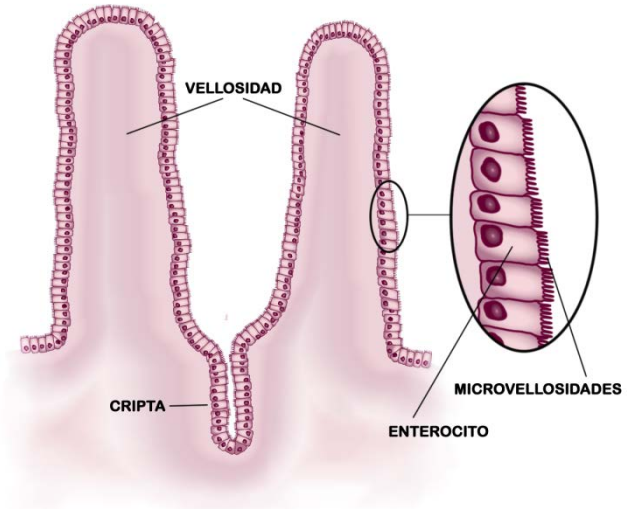
The **gallbladder** is a small organ located just under the liver whose function is to store and concentrate the bile secreted by the liver before it is released into the small intestine for the digestion.

The human body: nutrition

Digestive system

The **small intestine** absorbs the digested nutrients from food.

It has many small projections (***intestinal villi***) which increase the contact surface area of the intestinal walls making available a greater surface area for absorption of digested nutrients.



The chyme from the stomach is mixed in the small intestine with pancreatic juice, bile and intestinal juice, which allow its complete digestion.

The human body: nutrition

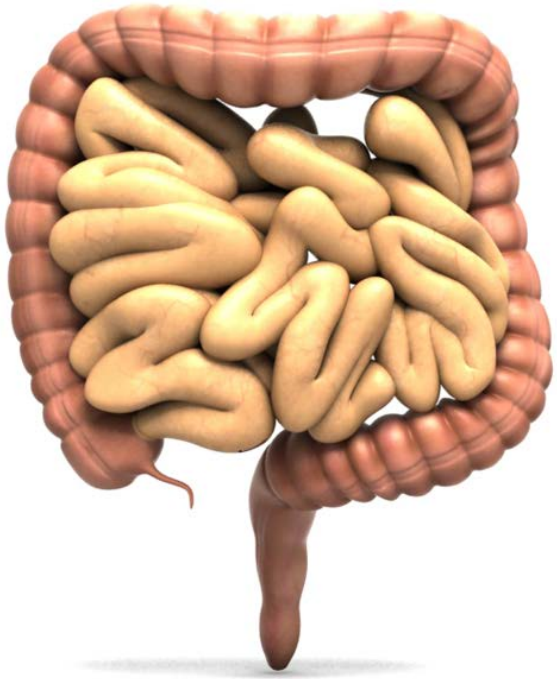
Digestive system

The **large intestine** absorbs water as well as the remaining digested nutrients. It also stores the waste products of digestion (***feces***).

Bacteria (***intestinal flora***) that produce vitamins (K and B12), which are also absorbed here, live in the large intestine.

The **appendix** is a vestigial organ without any known digestive functions.

Finally, the feces are eliminated from the organism through the **anus**.



The human body: nutrition

Respiratory system

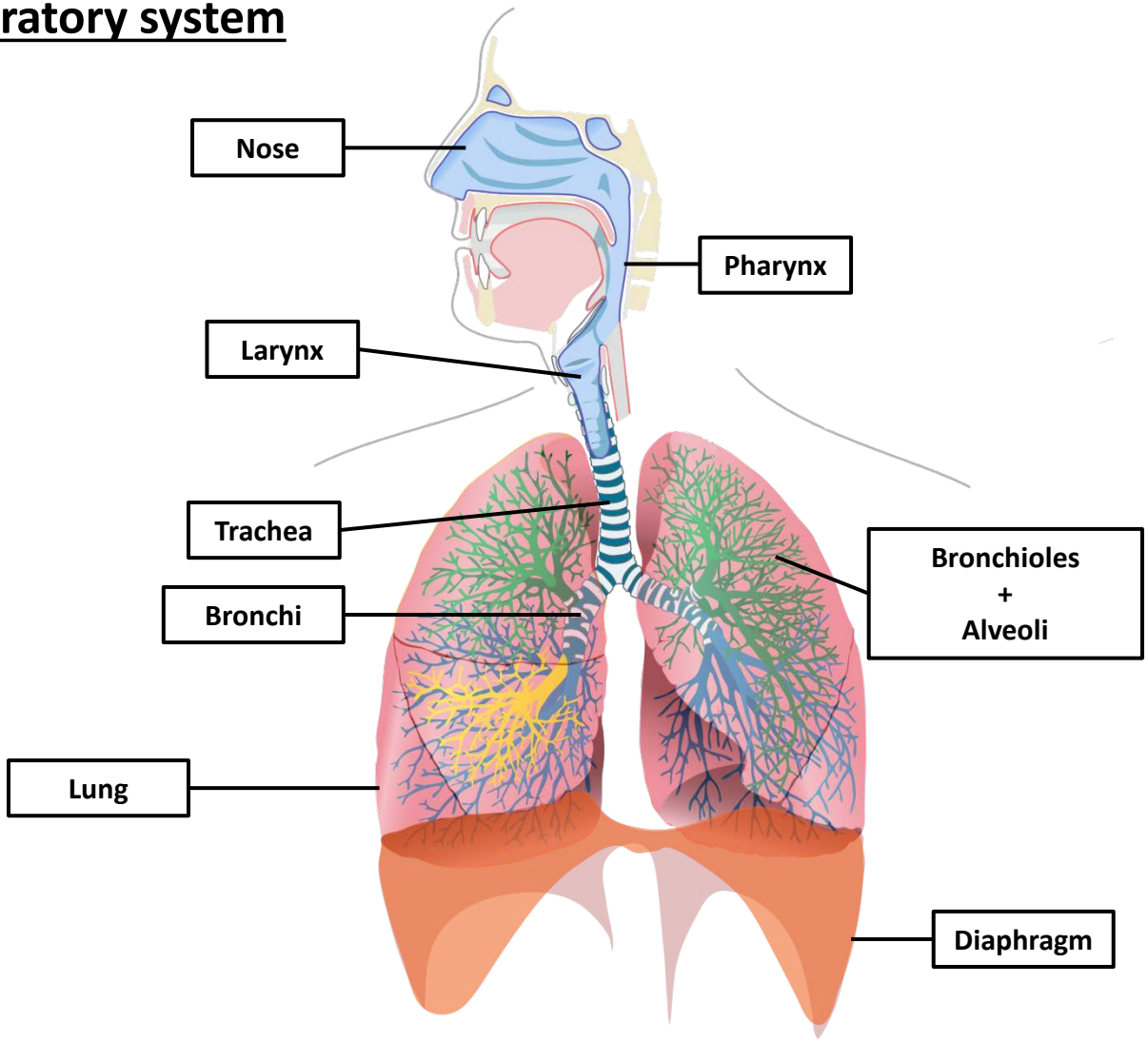


Image: LadyofHats

The human body: nutrition

Respiratory system

The function of the respiratory system is to move air into and out of the lungs (**respiration**).

- During ***inhalation*** (a.k.a. inspiration), the diaphragm and the muscles of respiration contract increasing the volume of the thoracic cavity and allowing air to enter the lungs.

- During ***exhalation*** (a.k.a. expiration), the thoracic cavity recovers its "resting position", allowing air to escape from the lungs.

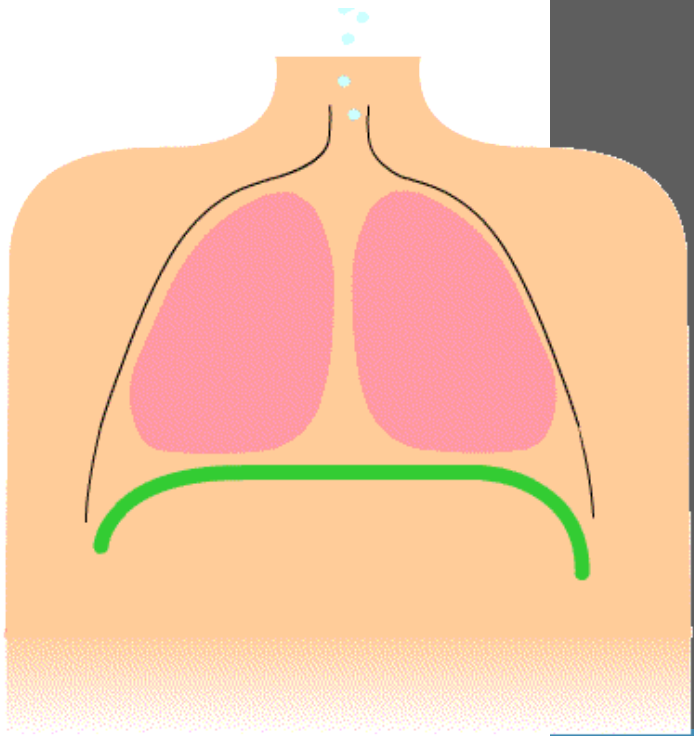


Image: John Pierce
CC0

The human body: nutrition

Respiratory system

Air is breathed in through the **nose**, where it is moistened, warmed and filtered.

Air travels to the lungs through the **pharynx** and **larynx**. The ***epiglottis*** opens to allow air to pass through, but closes to prevent food from going into the respiratory tract.

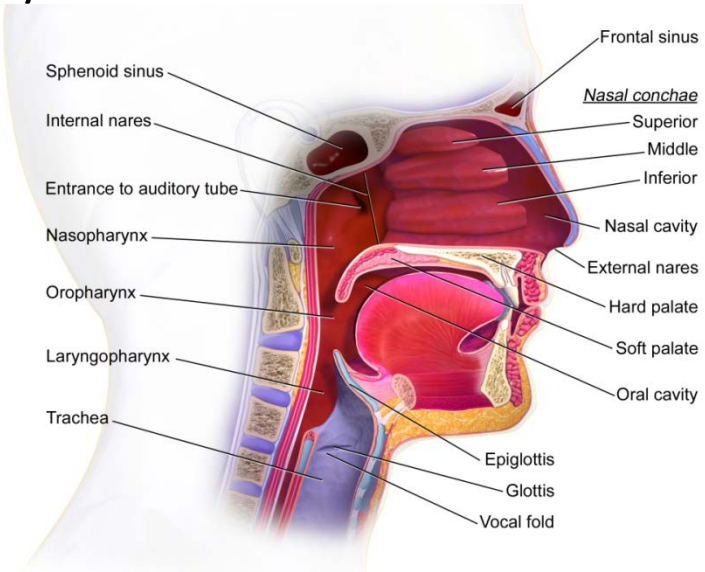


Image: BruceBlaus
CC BY 3.0

The larynx is the organ that allows humans to produce intelligible sounds (***voice***) by vibrating the air flow in the ***vocal cords***.

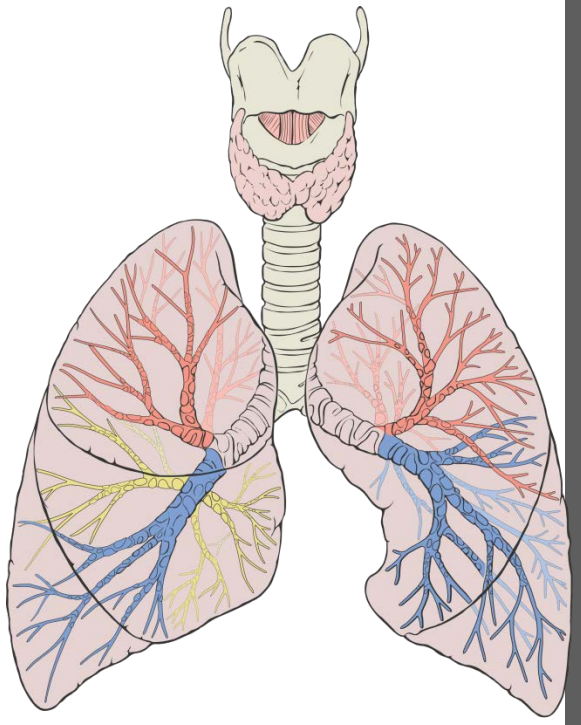
The human body: nutrition

Respiratory system

Air continues its travel to the lungs through the **trachea**, which branches into two conducts called **bronchi**, which enter the **lungs**.

Inside the lungs, the bronchi branch into smaller airways (**bronchioles** and **pulmonary alveoli**).

In the **lungs**, the blood receives oxygen from the air and carbon dioxide is released from the blood into the air.



The human body: nutrition

Respiratory system

The **pulmonary alveoli** is where the **gas exchange** between ***oxygen*** (O_2) and ***carbon dioxide*** (CO_2) occurs.

The blood rich in CO_2 is pumped from the body organs and tissues to the ***alveolar capillaries***, where the ***hemoglobin*** in the red blood cells releases a CO_2 molecule and takes an O_2 molecule.

All the cells in the human body use oxygen to obtain the ***energy*** they need from the oxidation of food in the ***mitochondria***. Carbon dioxide is released as a byproduct of this process.

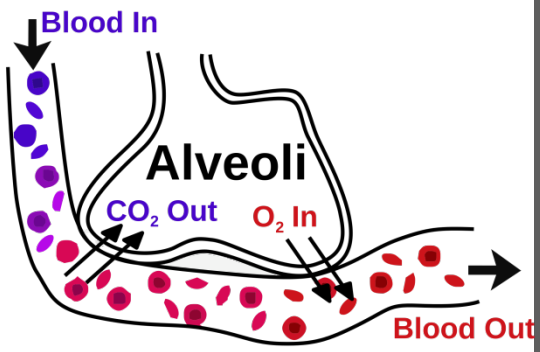


Image: helix84
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The human body: nutrition

Circulatory system

The main function of the circulatory system is to transport nutrients to the cells of the body and collect the waste products that need to be eliminated from those same cells.

The circulatory system consists of:

- **heart**
- **blood vessels** (arteries, veins and capillaries)
- **blood**

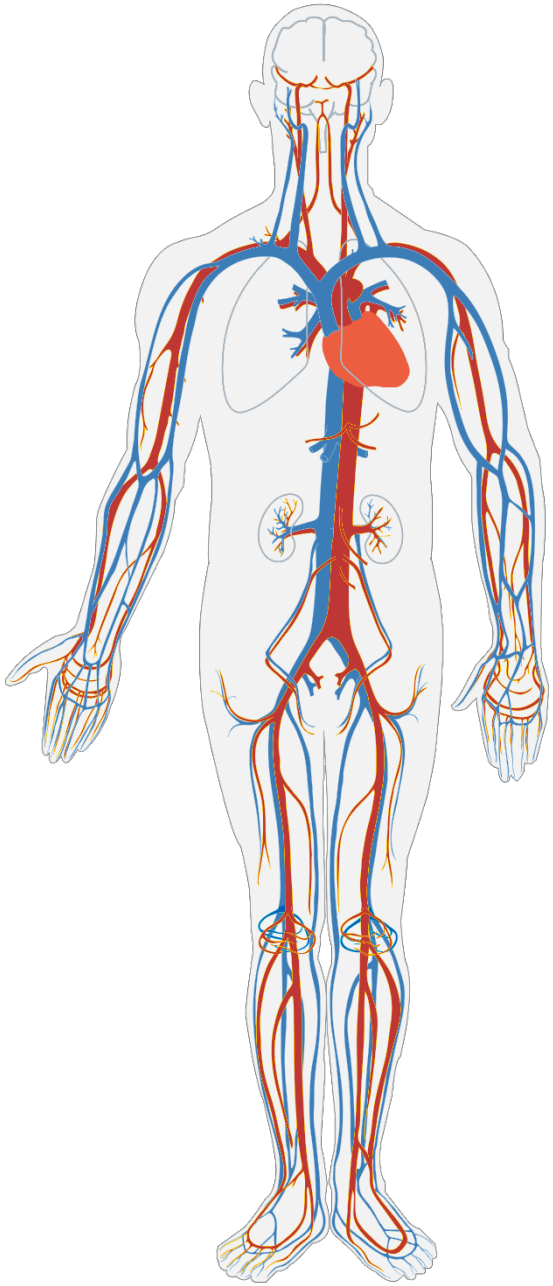


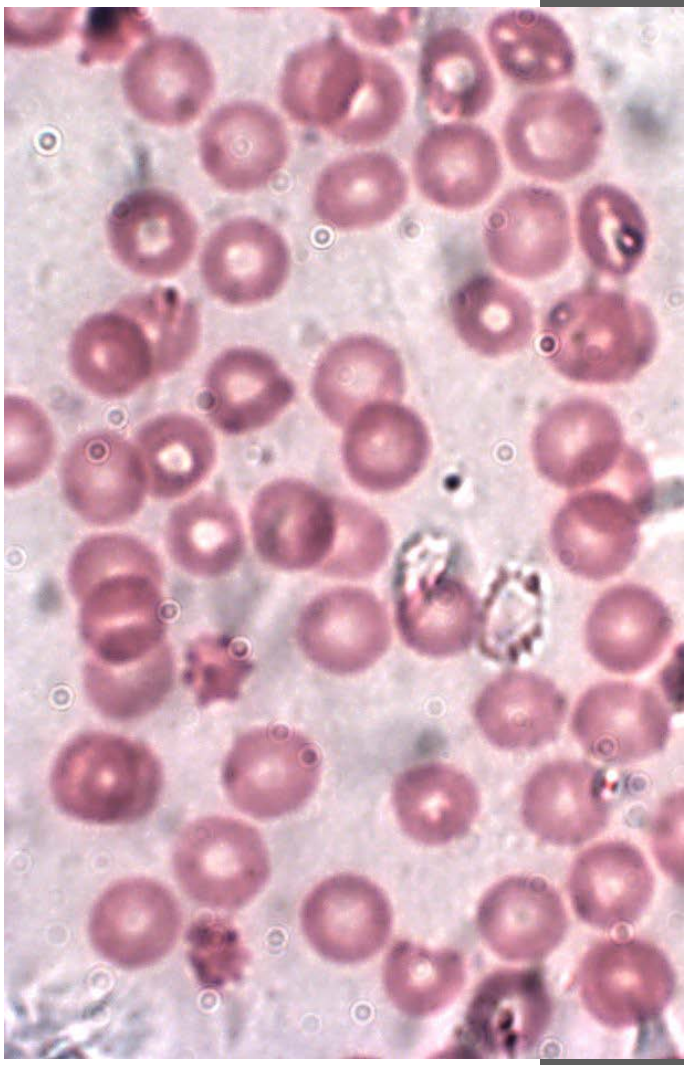
Image: LadyofHats

The human body: nutrition

Circulatory system

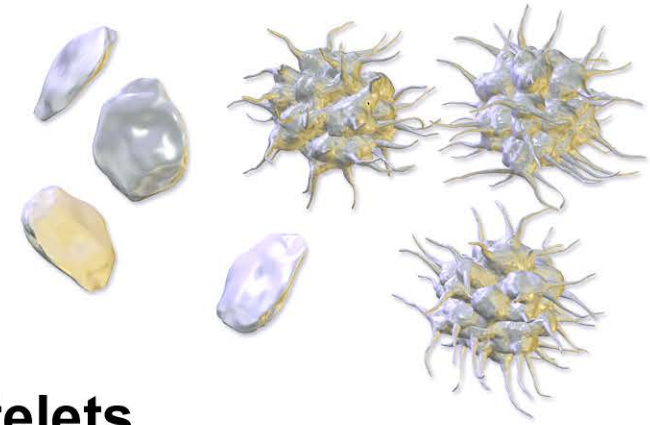
Blood is a fluid that circulates around the body through blood vessels, delivering nutrients and oxygen to the cells and transporting waste products away from them. It consists of:

- **cells: red blood cells** (a.k.a. ***RBCs***), which deliver oxygen to the body tissues and collect carbon dioxide; **white blood cells** (a.k.a. ***leukocytes***), which protect the body against both infections and foreign invaders; **platelets**, which help stop bleeding by initiating a blood clot.
- **blood plasma:** liquid component of the blood that holds blood cells, nutrients and waste substances in suspension.

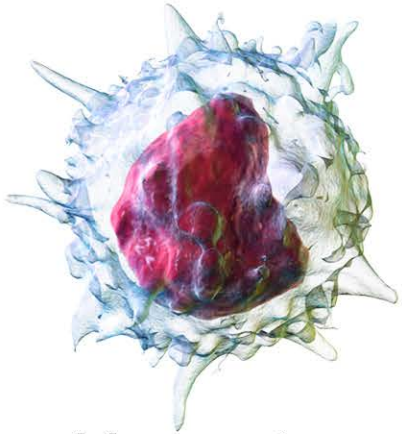


Formed Elements of Blood

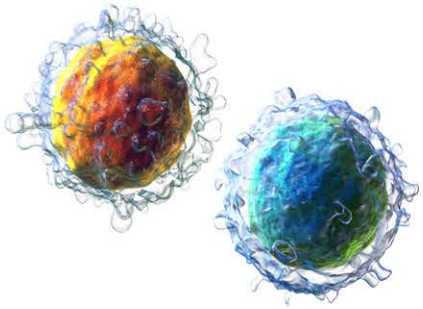
Red Blood Cells



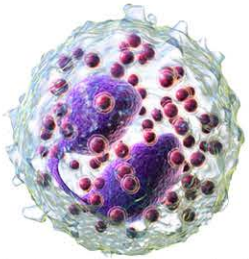
Platelets



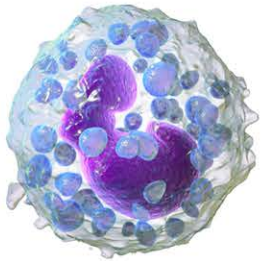
Monocyte



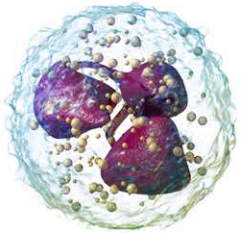
Lymphocytes



Eosinophil



Basophil



Neutrophil

White Blood Cells

The human body: nutrition

Circulatory system

In the human body, blood circulates inside a **closed system** of blood vessels. Besides, the human circulatory system is a **double system**, since it has two components: one loop (***pulmonary circulation***) to and from the lungs, where blood is oxygenated, and one loop (***systemic circulation***) to and from the body to provide oxygenated blood to the body organs and tissues.

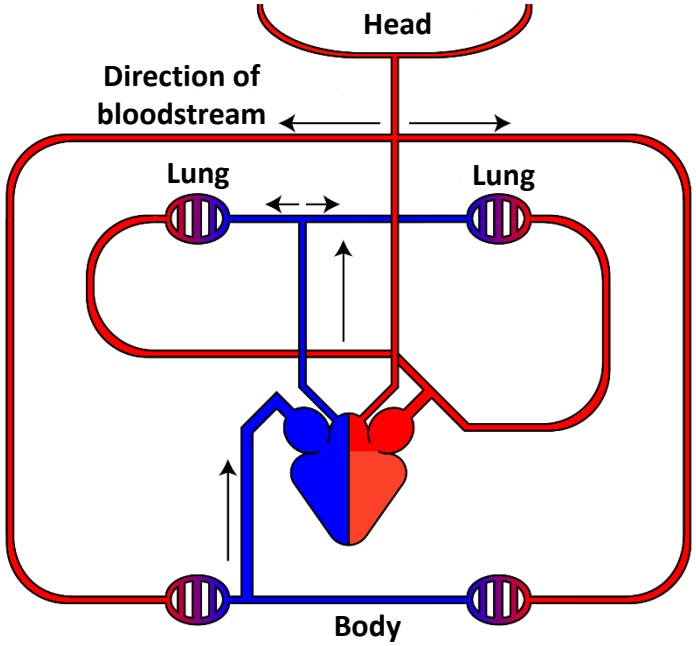


Image: Lennert B / A.R. Esteve
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The human body: nutrition

Circulatory system

The **arteries** carry the blood away from the heart to the whole body. They are elastic to withstand the pressure of the circulating blood on their walls (***blood pressure***).

Examples: aorta, carotid, etc.

Veins carry the blood from the whole body to the heart. They are generally thinner than arteries since they are not subject to high blood pressures as arteries are.

Examples: jugular veins, venae cavae, etc.

Capillaries are small and thin blood vessels which enable the exchange of substances between the blood and the body tissues.

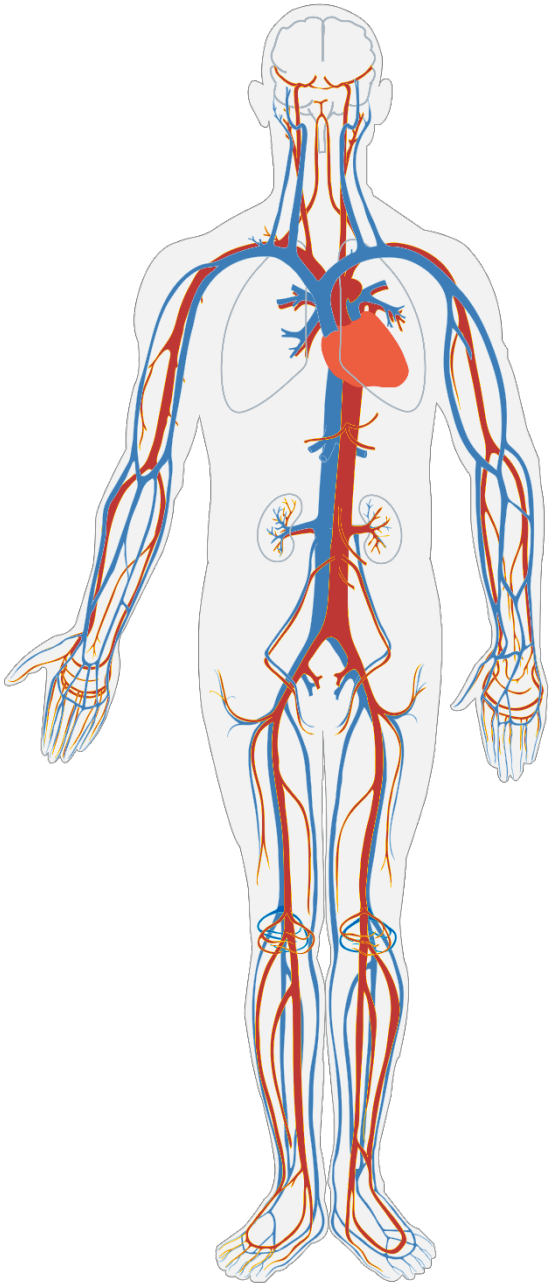
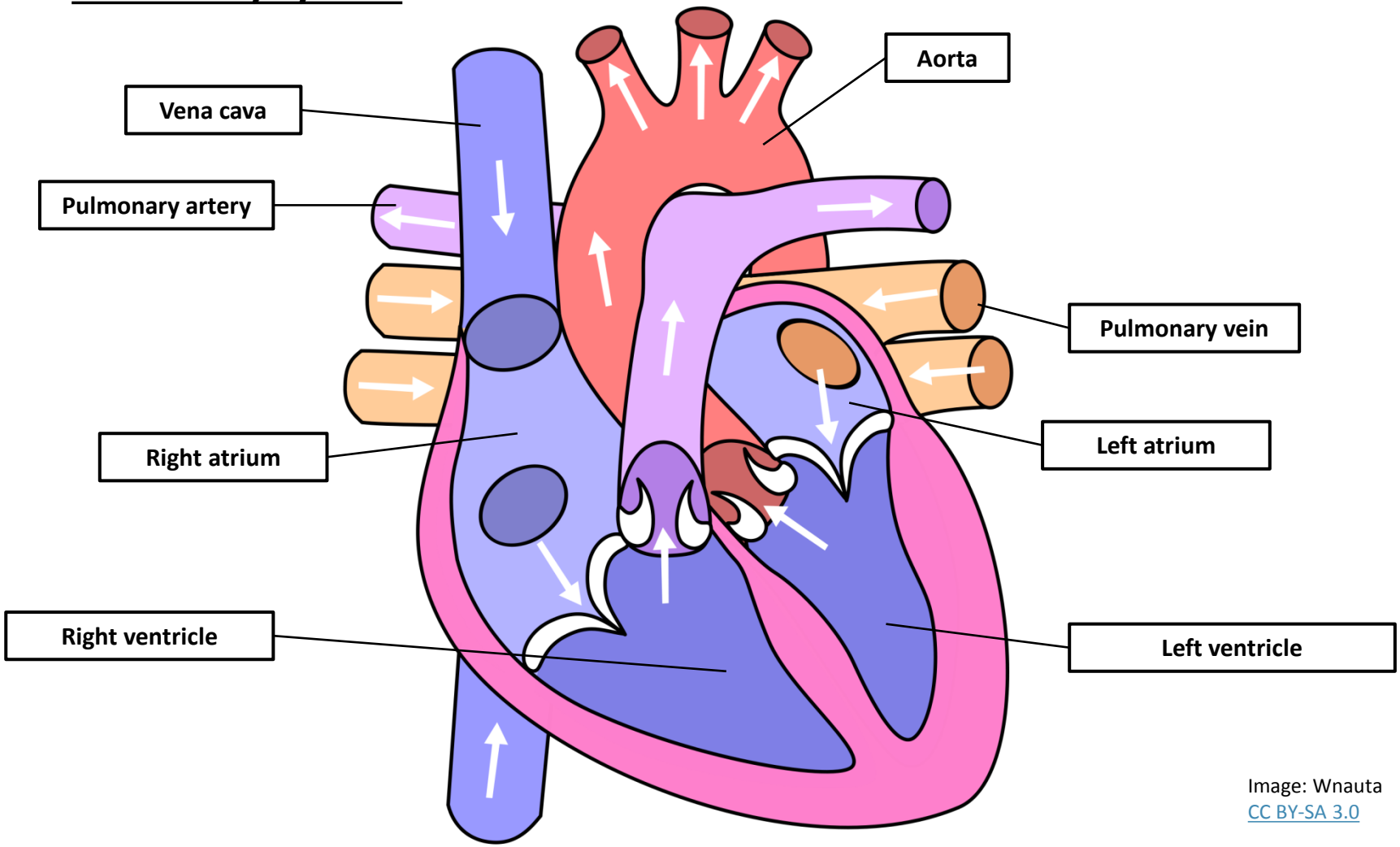


Image: LadyofHats

The human body: nutrition

Circulatory system



The human body: nutrition

Circulatory system

The **heart** is a hollow organ that pumps blood through the blood vessels in order to provide a continuous flow of blood throughout the body.

The heart is made up of a muscle tissue called ***myocardium***.

The heart is divided into four chambers: the (right and left) **atria**, located in the upper part, and the (right and left) **ventricles**, located in the lower part. Each atrium is communicated with the ventricle on the same side by a valve. The left side and the right side of the heart are not communicated.

The human body: nutrition

Circulatory system

Blood from the whole body enters the **right atrium** through the **venae cavae.** Blood from the lungs enters the **left atrium** through the **pulmonary veins**. When both chambers are filled with blood, they contract sending it to the ventricles through their valves (***atrial systole***).

Next, the right ventricle and the left ventricle contract pumping blood to the whole body and to the lungs, respectively (***ventricular systole***). Blood leaves the **right ventricle** through the **pulmonary artery.** Blood leaves the **left ventricle** through the **aorta**.

Finally, the heart relaxes (***diastole***) and the cardiac cycle starts again.

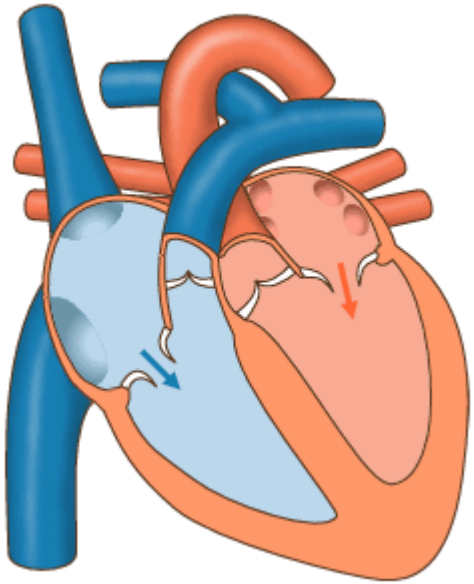
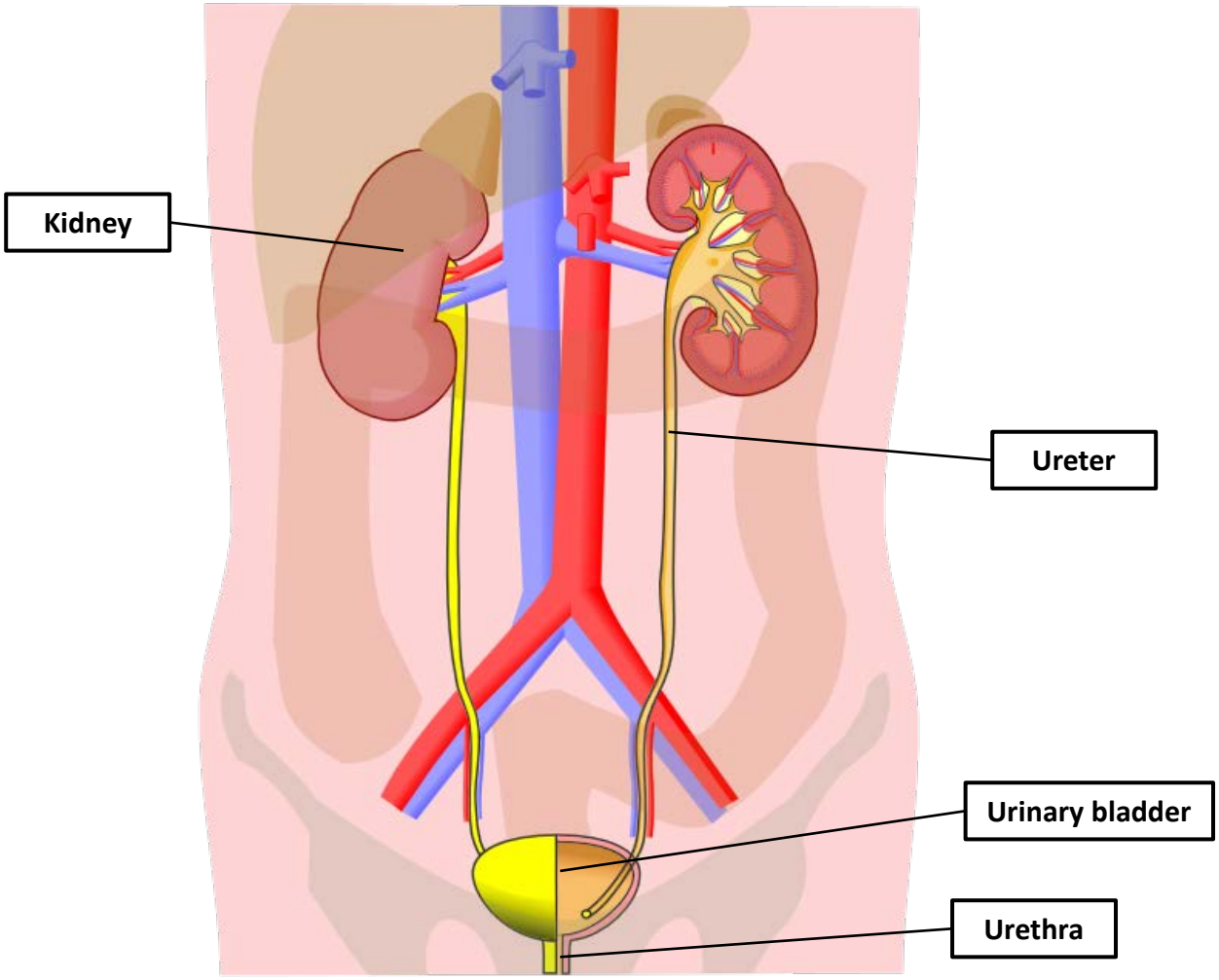


Image: josiño

The human body: nutrition

Excretory system



The human body: nutrition

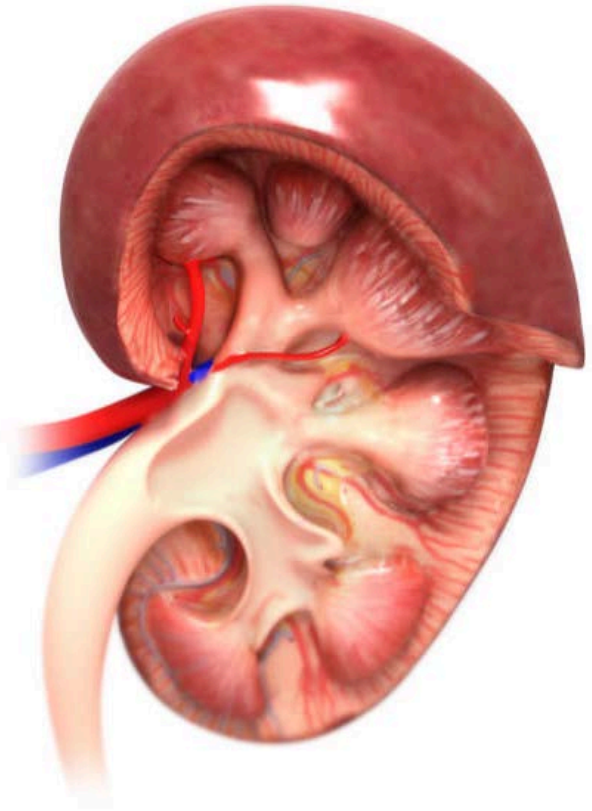
Excretory system

The waste products from the activity of the cells enter the **kidneys** through the ***renal artery*** diluted in the blood.

The kidneys are made up of microscopic units called ***nephrons***, which filter the blood, reabsorb most of the water and many of the dissolved substances that are useful for the body, and excrete the rest as ***urine*** (water, mineral salts, urea and uric acid).

The blood filtered by the kidneys exits through the ***renal veins.***

Urine exits the kidneys through the **ureters**.



The human body: nutrition

Excretory system

The **ureters** take urine from the kidneys to the **urinary bladder**, which collects and releases urine through the **urethra** to the outside of the body.

The **urinary bladder** is a hollow and elastic organ made up of muscle tissue that stretches as it stores urine. When the urinary bladder is full, a signal is sent to the brain.

The **urethra** is different in women and men. In ***women***, the urethra is short (~5 cm) and exits the body between the clitoris and the vagina. In ***men***, the urethra is long (~20 cm), runs along the length of the penis and provides an exit for semen to the outside of the body (reproductive function).

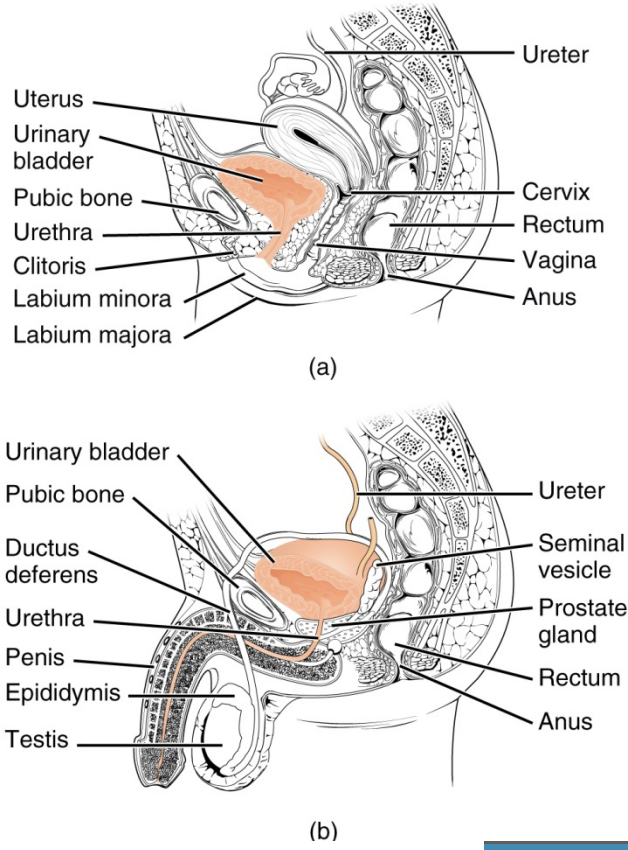


Image: OpenStax College
Anatomy & Physiology Connexions Web site
http://cnx.org/content/col11496/1.6/
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The human body: nutrition

Excretory system

Other organs are also considered part of the excretory system:

- **Skin:** the ***sweat glands*** in the skin secrete a substance called ***sweat*** (water, mineral salts, and organic substances) in order to eliminate excess salts and regulate body temperature.

- **Lungs:** they excrete carbon dioxide produced during respiration.

The human body: response

Organisms have the ability to respond to external or internal stimuli.

Image: freestocks.org
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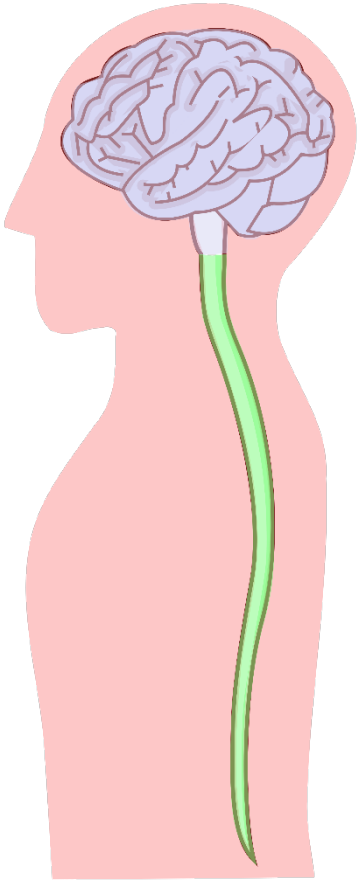
The human body: response

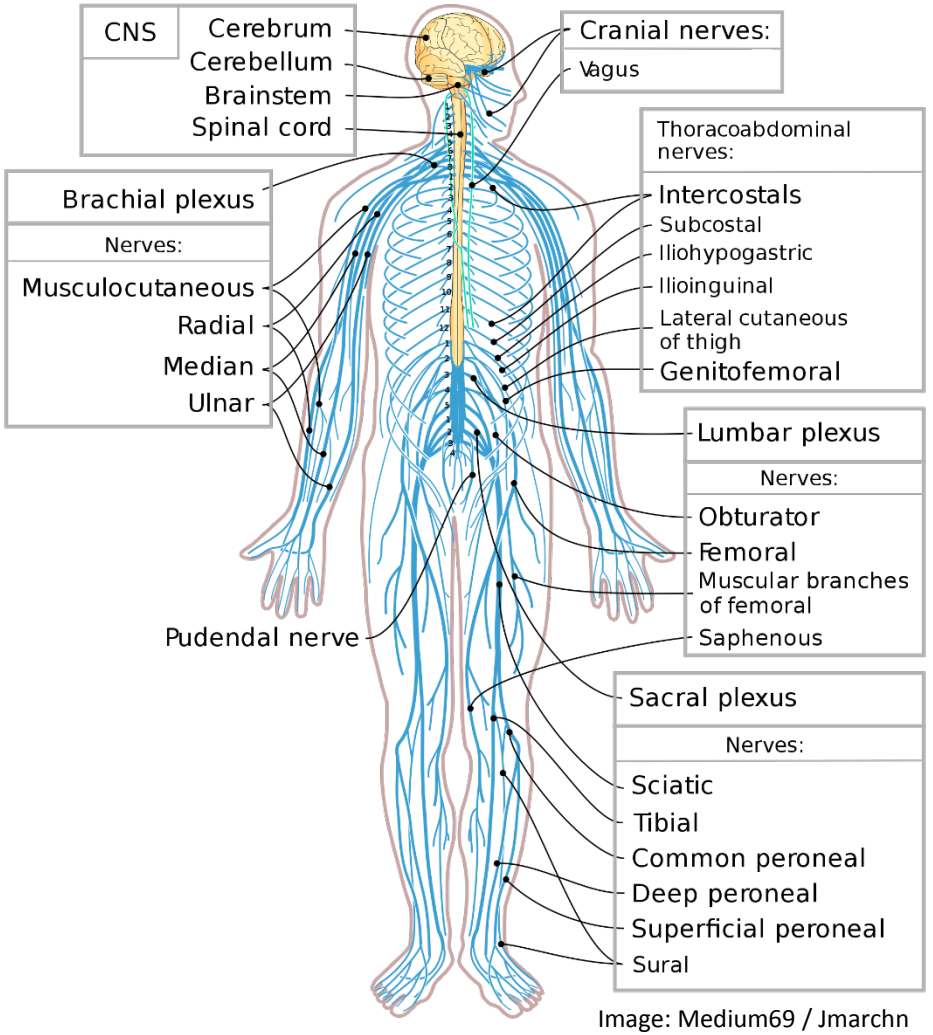
In human response, the following systems participate:

- The **nervous system** extracts information from the environment and coordinates the actions of different body parts to respond to that information.
- The **locomotor system** gives humans the ability to move. It also provides form, support and stability to the human body.
- The **endocrine system** secretes substances called ***hormones*** which are released into the bloodstream and control many body functions.

The human body: response

Nervous system





The human body: response

Nervous system

The human **nervous system** extracts information from the environment and coordinates the actions of different body parts to respond to that information. It consists of two parts:

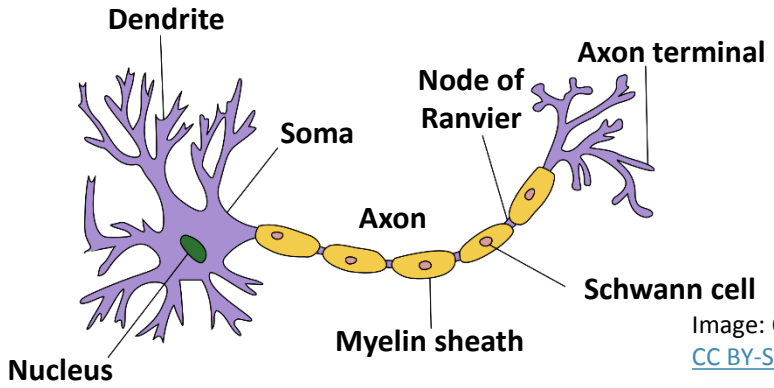
- The **central nervous system** (CNS) gathers information from the environment and coordinates the response of the body. It consists of the ***brain*** and the ***spinal cord***.

- The **peripheral nervous system** (PNS) connects the central nervous system to the different parts of the body. It consists mainly of ***nerves***.

The human body: response

Nervous system

Neurons are the cells of the nervous system.* They are specialized in the reception of stimuli and the transmission of electrical signals (***nerve impulses***) to other neurons, muscles or glands.



Neurons consist of a cell body (***soma***), several short extensions (***dendrites***) that propagate the nerve impulses to the neurons, and a long projection (***axon***) that conduct the nerve impulses away from the cell body.

*This theory, called ***"neuron doctrine"***, was developed by **Santiago Ramón y Cajal** in the late 19th century (Nobel Prize in Medicine in 1906).

The human body: response

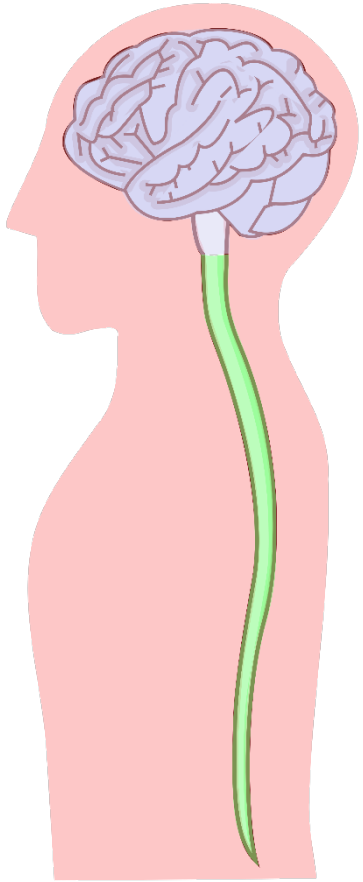
Nervous system

The **central nervous system** (CNS) gathers information from the environment and processes it to determine an appropriate response, which will be transmitted as nerve impulses to the muscles or glands.

It is protected by bony structures (***skull*** and ***vertebrae***) and membranes called ***meninges***.

It consists of:

- the **brain**, which is located in the skull, is the control center of most activities of the body. It is also responsible for cognition, language, and emotions. It consists of the ***cerebrum***, the ***cerebellum***, and the ***brainstem***.
- the **spinal cord**, which is located inside the vertebral column (a.k.a. spine), transmits the nerve impulses from the brain to the body and viceversa.



The human body: response

Nervous system

The **peripheral nervous system** (PNS) connects the central nervous system to the different parts of the body. It consists mainly of ***nerves***.

It is divided into:

- the ***somatic nervous system***, which is associated with the voluntary control of body movements via skeletal muscles.
- the ***autonomic nervous system***, which acts mostly unconsciously and regulates body functions (*e.g., heart rate, digestion, breathing, etc.*).

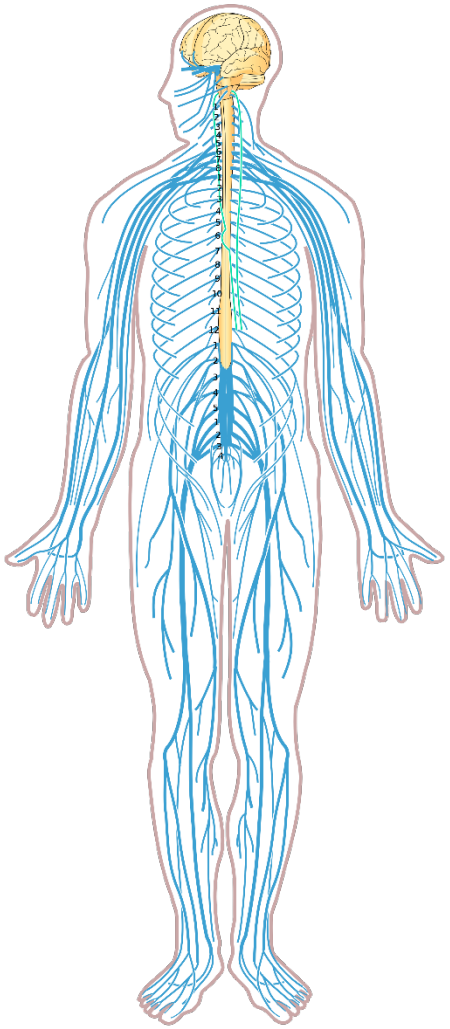


Image: William Crochot

The human body: response

Locomotor system

Image: LadyofHats / Mikael Häggström

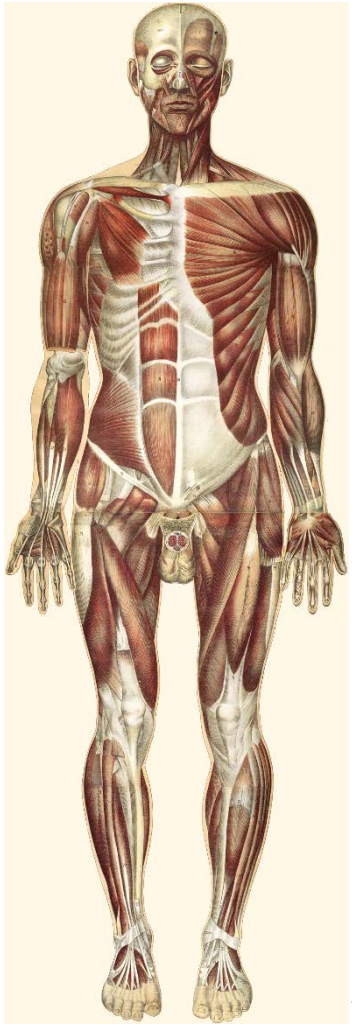


Image: Julien Bouglé
https://www.nlm.nih.gov/exhibition/historicalanatomies/bougle_home.html

The human body: response

Locomotor system

The **locomotor system** gives humans the ability to move. It also provides form, support and stability to the human body. It consists of:

- **skeletal system**, which supports the body and protects its vital organs. It is made up of ***bones***, ***joints***, and ***ligaments***.

- **muscular system**, which keeps bones in place and permits the movement of bones and the body. It is made up of ***muscles*** and ***tendons***, which connect muscles to bones.

The human body contains approximately ***206 bones*** and ***320 muscles***.

The human body: response

Locomotor system

Bones are composed of two types of bone tissue:

- **Compact bone**, which is found in the outer layer of bones. It is hard and dense. It gives bones their smooth, white, and solid appearance. It facilitates bones' main functions: to ***support the whole body***, ***protect internal organs***, ***permit movement***, and ***store and release chemical elements*** such as calcium and phosphorus.
- **Spongy bone**, which is found inside bones. It is weaker and more flexible than compact bone. It may contain ***bone marrow***, where blood cells are produced (leukocytes, red blood cells and platelets).

The human body: response

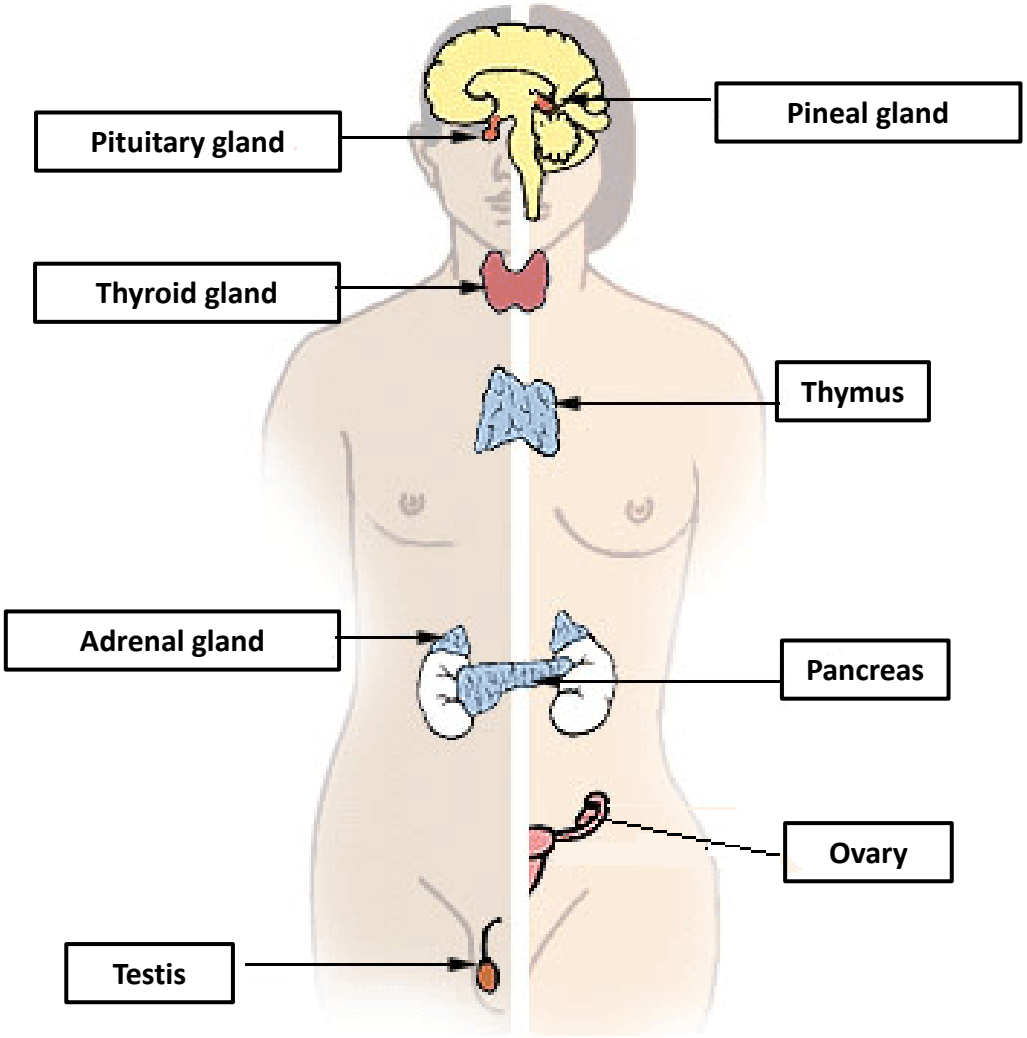
Locomotor system

Muscles are composed of three types of muscle tissue:

- **Skeletal muscle**, which is made up of long muscle fibers. It is characterized by its ***voluntary contraction***, which is controlled by the Central Nervous System. It is responsible for the movement of the skeleton and maintaining the posture of the body. *Examples: biceps, quadriceps, deltoids.*
- **Smooth muscle**, which is found within the walls of hollow organs (*e.g., stomach, intestine, bladder, uterus*) and blood vessels (*e.g., arteries, veins*). It does not contract voluntarily.
- **Cardiac muscle**, a.k.a. ***myocardium***, is found only in the heart. Its contraction is involuntary.

The human body: response

Endocrine system



The human body: response

Endocrine system

The human **endocrine system** consists of several **endocrine glands** which secrete substances called **hormones** that are transported by the circulatory system to target distant organs to regulate many body functions.

The main endocrine glands of the human body are: the ***pineal gland***, ***pituitary gland***, ***thyroid gland***, ***thymus***, ***pancreas***, ***adrenal glands***, and ***gonads*** (ovaries in women and testes in men).

Besides, other organs of the human body also have endocrine functions. *Examples: the kidneys, liver.*

The human body: response

Endocrine system

The **pineal gland** is located near the center of the brain. It produces a hormone called melatonin, which ***modulates sleep patterns***.

The **pituitary gland** is located at the base of the brain. It produces hormones (*e.g., growth hormone, prolactin, oxytocin*) that ***regulate the function of other endocrine organs***.

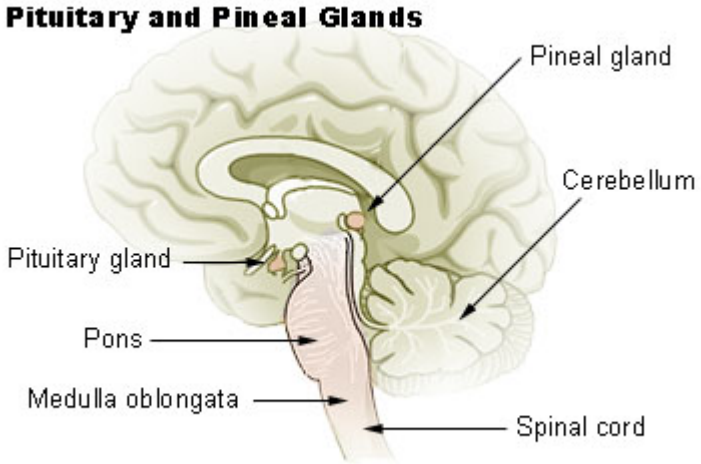


Image: http://training.seer.cancer.gov/anatomy/endocrine/glands/pituitary.html

The human body: response

Endocrine system

The **thyroid gland** is located at the front of the neck, below the Adam's apple. It produces hormones (*e.g., thyroxine*) that ***regulate the body's metabolism and development***.

The **adrenal glands** are located above the kidneys. They produce hormones (*e.g., cortisol, adrenaline, dopamine*) that ***control the body response in stress situations***.

The **pancreas** is located below and behind the stomach. It is a mixed gland since it is part of both the **digestive system** and the **endocrine system**. It produces the hormones (insulin and glucagon) that ***regulate blood sugar levels***.

The human body: response

Endocrine system

The **gonads** (a.k.a. ***sex glands***) are mixed glands since they are part of both the **reproductive system** and the **endocrine system**. They produce, since puberty, ***sex hormones*** that are responsible for the development and regulation of the reproductive system and secondary sex characteristics.

- the women's **ovaries** produce ***estrogens***, which regulate the development of secondary sex characteristics and the menstrual cycle, and ***progesterone***, which is involved in the menstrual cycle and pregnancy.

- the men's **testes** produce ***testosterone***, which regulates the development of secondary sex characteristics and the production of sperm.

The human body: reproduction

Reproduction is the process by which organisms perpetuate, transmitting the genetic information of the species from generation to generation.

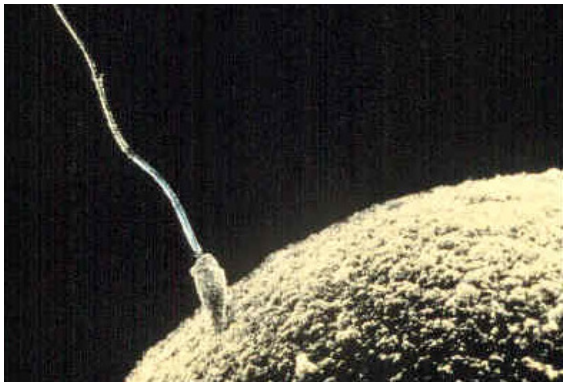


Image: http://www.pdimages.com/web9.htm

Image: Mikael Häggström
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The human reproduction is **sexual**, i.e., involves the reproductive cells (***gametes***) of a woman and a man. Besides, the development of the new individual is **viviparous**, i.e., it occurs inside the woman's body.

The human body: reproduction

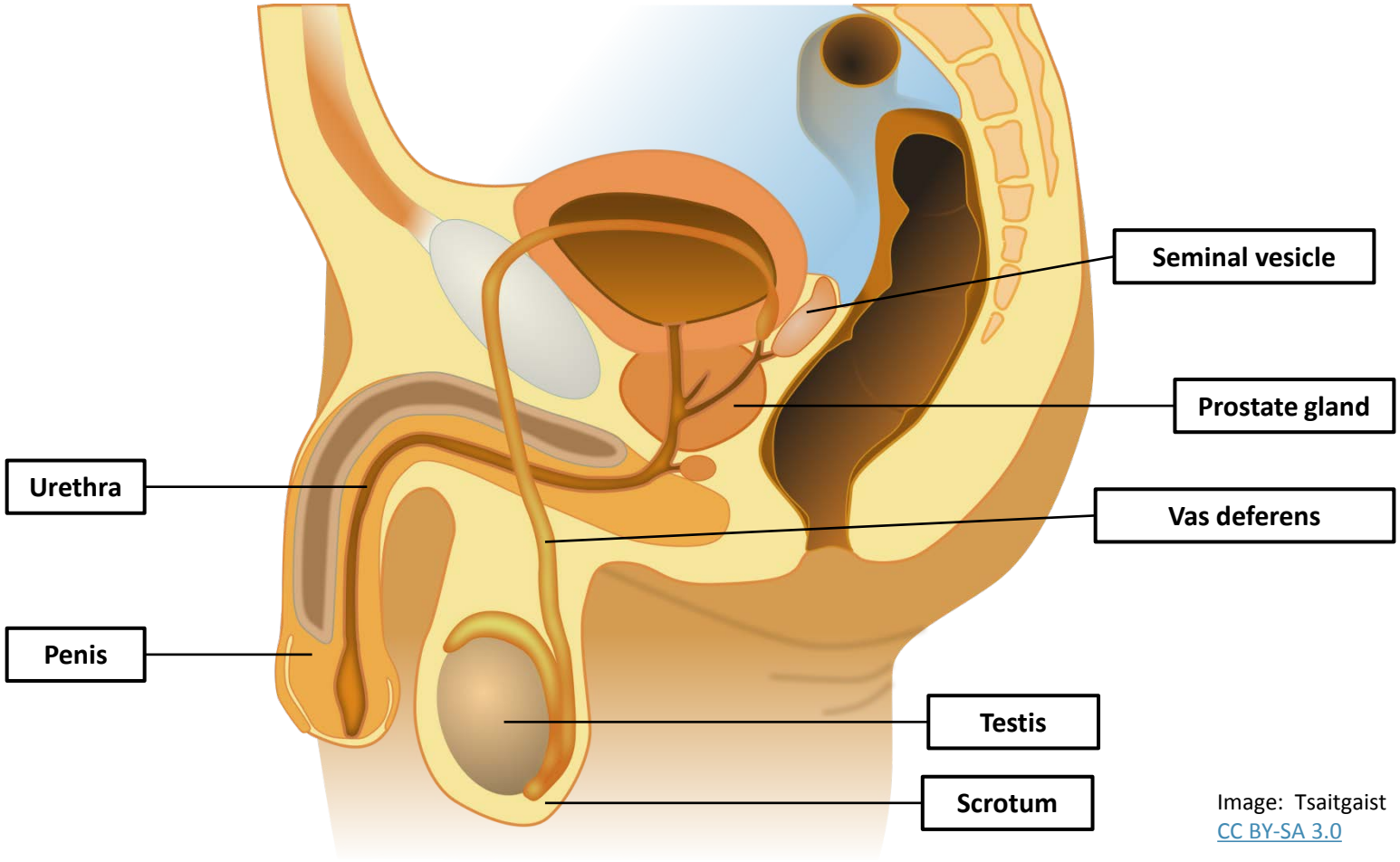
Sexual reproduction typically involves sexual intercourse between individuals of two sexes which have different reproductive systems:

- **Male reproductive system**, which produces, stores and releases the male gametes (***sperm*** a.k.a. spermatozoa).

- **Female reproductive system**, which produces the female gametes (***egg cells*** a.k.a. ovum) and accommodates the ***fetus*** during gestation.

The human body: reproduction

Male reproductive system



The human body: reproduction

Male reproductive system

External genital organs

- **Penis.** It is the male intromittent organ. It also serves as the urinal duct.
- **Scrotum.** It is a suspended sack of skin and muscle that holds and protects the testicles.

Internal genital organs

- **Testicles** (a.k.a. ***testis***). They produce the male gametes (***sperm***). This process starts at puberty and lasts all life.
- **Vas deferens** (a.k.a. sperm duct)**.** They carry the sperm from the testicles to the urethra.
- **Seminal vesicles.** They produce ***seminal fluid***, which promote the survival of sperm.
- **Prostate.** It produces ***seminal fluid*** and participates in ejaculation.
- **Urethra.** It is a tube that runs along the length of the penis, providing an exit for sperm to the outside of the man's body.

The human body: reproduction

Female reproductive system

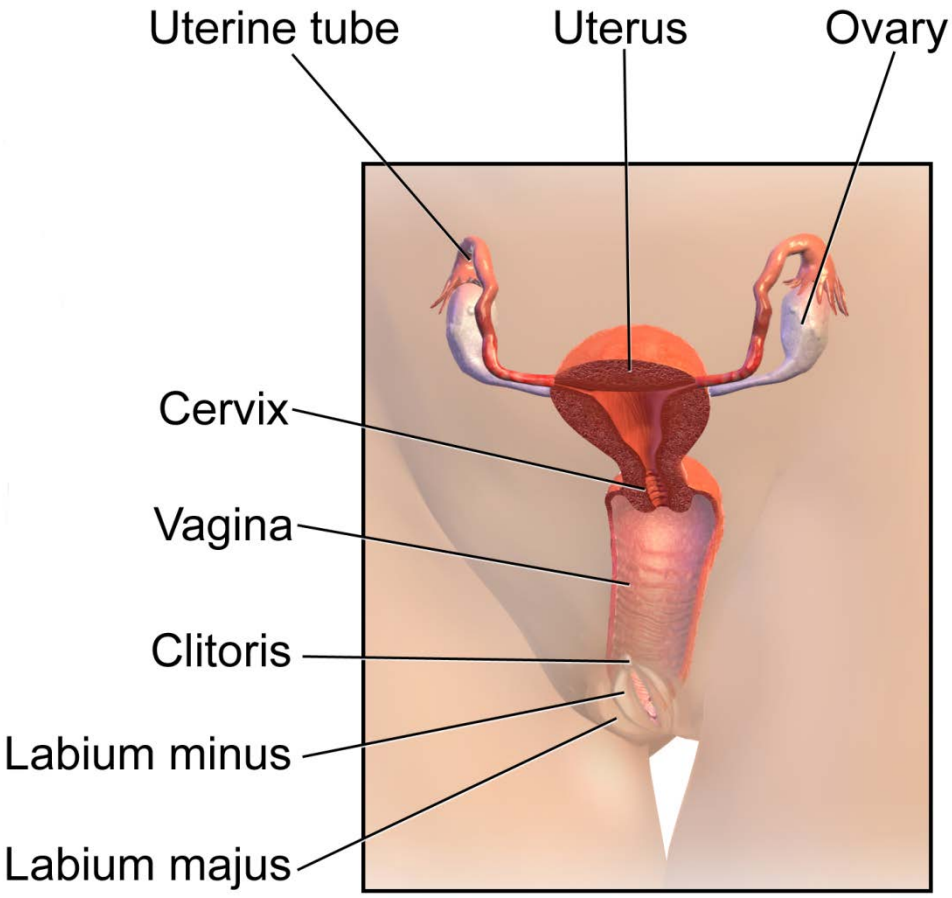


Image: BruceBlaus
Medical gallery of Blausen Medical 2014.
WikiJournal of Medicine 1 (2).
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The human body: reproduction

Female reproductive system

Internal genital organs

- **Ovaries.** They are the small organs where the female gametes (***egg cells***) are produced and periodically released. The egg cells are present in the ovaries since birth (~250 000), although only a few will mature between ***menarche*** and ***menopause***.
- **Fallopian tubes.** They are the tubes that go from the ovaries to the uterus. It is where fertilization takes place.
- **Uterus.** It is the hollow organ where the fetus develops during gestation.
- **Vagina.** It is the canal that goes from the uterus to the outside of the body. It is where the sperm is released.

External genital organs

- **Clitoris.** Its only known purpose is to provide sexual pleasure.
- **Labia *(majora and minora)***. Folds of skin that surround and protect the clitoris and the openings of the vagina and the urethra.

The human body: reproduction

Menstrual cycle

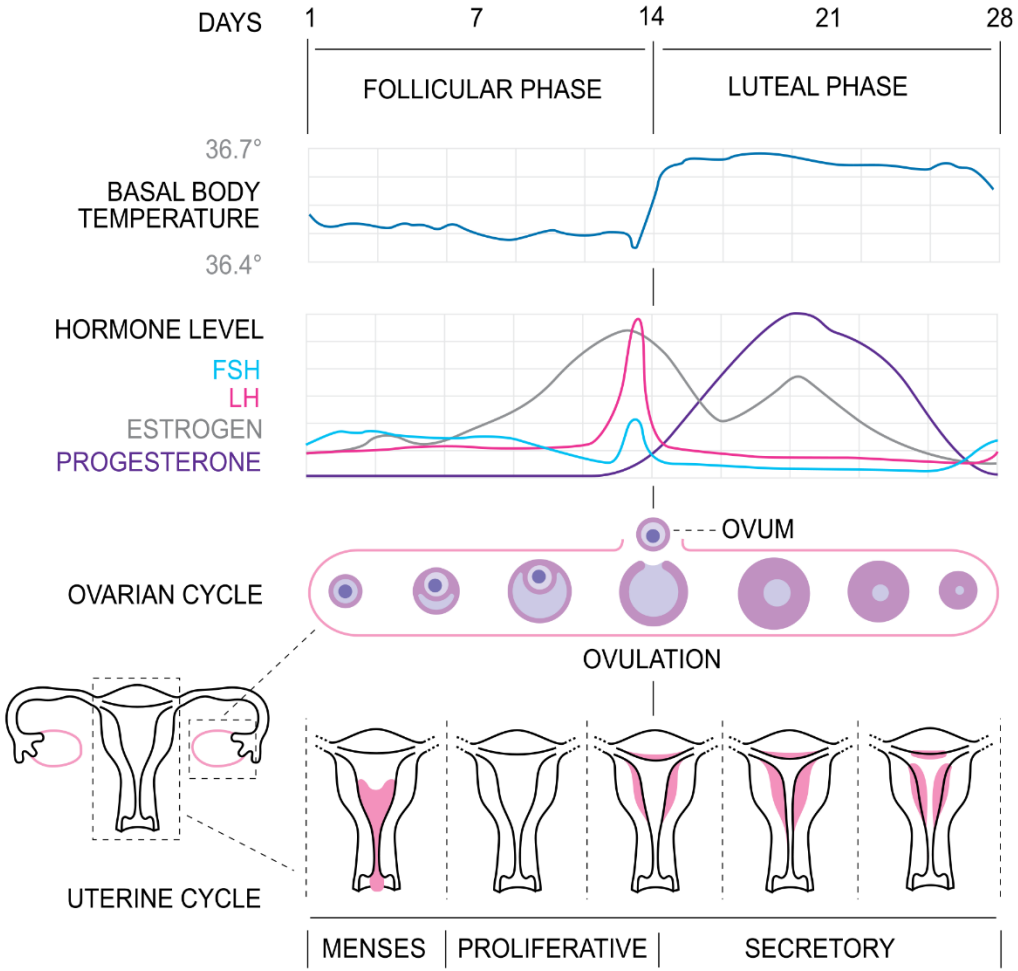
At puberty, women start to experience a series of regular natural changes in their reproductive system (**menstrual cycle**).

During the menstrual cycle, the female gametes (***egg cells***) are matured and released, making **pregnancy** possible. If the egg cell is not fertilized, **menstruation** (a.k.a. ***period***) will occur.

The menstrual cycle usually lasts an average of 28 days.

The human body: reproduction

Menstrual cycle



The human body: reproduction

Menstrual cycle

The menstrual cycle consists of four phases:

1. **Follicular phase** (days 1 – 13). Hormones stimulate the ovary so it can start to ***mature an egg***. Besides, the ovaries produce estrogen, which initiates the formation of a ***new layer of endometrium*** in the uterus in order to create an optimal environment for the implantation of the fertilized egg.
2. **Ovulation** (days 14 – 15). The mature ***egg is released*** from the ovary into the ***Fallopian tube***, where it will be available to be fertilized by sperm.
3. **Luteal phase** (days 16 – 28). If the ***egg*** is not fertilized, it will disintegrate and be ***eliminated*** by vaginal bleeding during ***menstruation***.
4. **Menstruation** (days 1 – 4). The ***endometrium sheds from the uterus*** and is ***eliminated by vaginal bleeding***. The menstrual cycle starts again.

The human body: reproduction

Fertilization, pregnancy and birth

Fertilization is the union of an egg and sperm to produce a new individual. In humans, it occurs inside the woman's body (***internal fertilization***), usually in one of the **Fallopian tubes**.

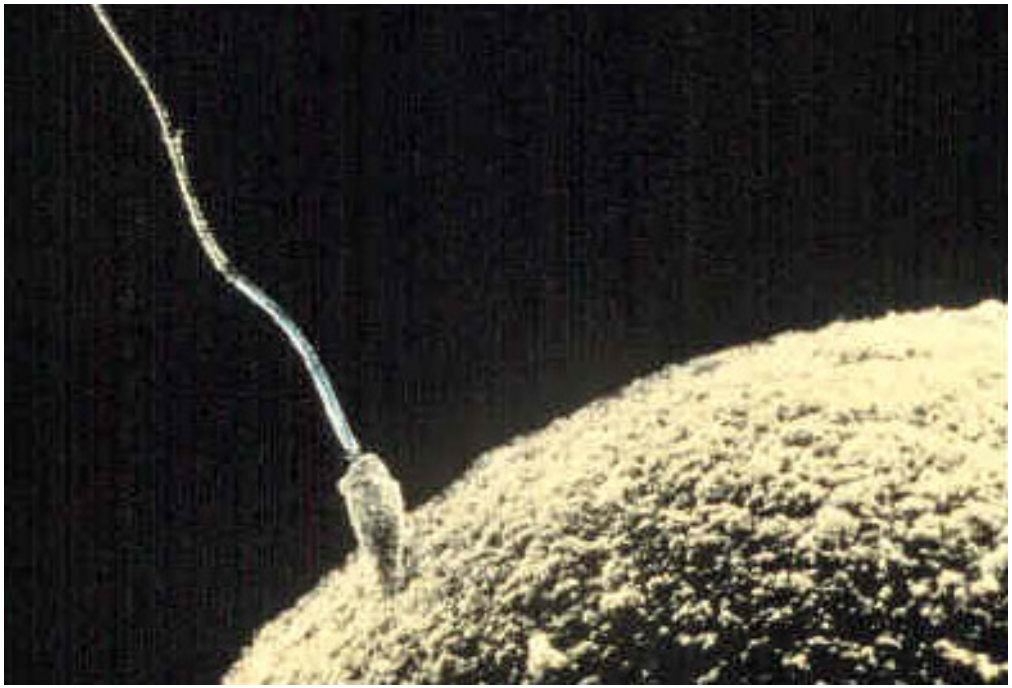


Image: http://www.pdimages.com/web9.htm

The human body: reproduction

Fertilization, pregnancy and birth

To guarantee the fertilization of the egg, ***millions of sperm*** are released, but only a few will reach the egg and ***only one will enter the egg***.

The union of the egg and the sperm produces a new cell called **zygote**, which contains all the genetic information necessary to form a new individual. In humans, the zygote has 46 chromosomes in total (23 pairs), with 23 chromosomes from each parent.

The zygote will divide several times (***mitosis***), becoming a multicellular **embryo** that will be implanted in the uterus and that will develop into the ***placenta*** (an organ that allows the fetus to perform gas exchange, nutrient uptake and waste elimination during its development) and the ***fetus***.

The human body: reproduction

Fertilization, pregnancy and birth

Pregnancy is the time period between the implantation of the embryo in the uterus until birth. In humans, pregnancy is about 38 - 40 weeks (approximately about 9 months).

Image: Ed Uthman, MD

The human body: reproduction

Fertilization, pregnancy and birth

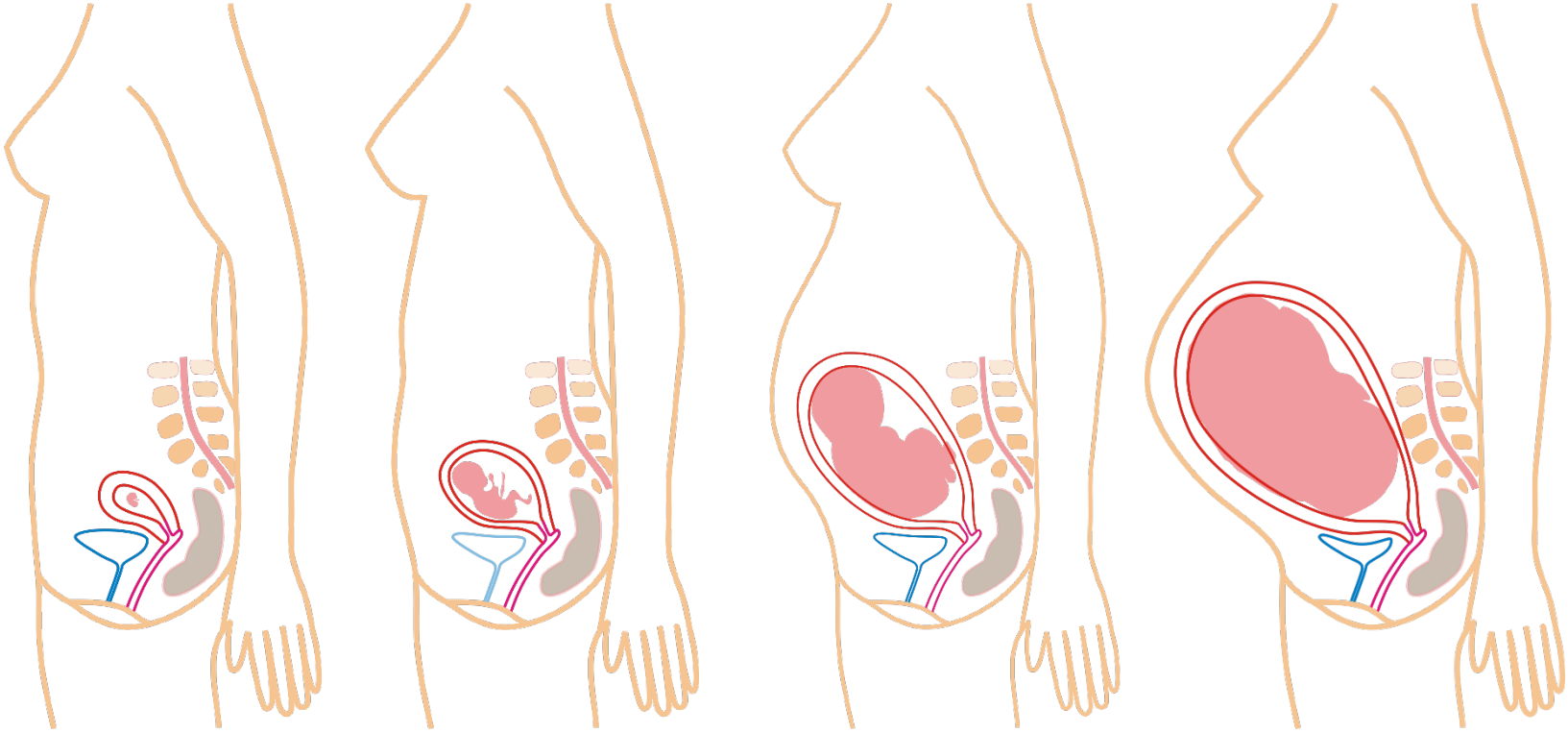
During pregnancy, the new individual develops in two stages:

- **Embryonic period** (weeks 1 to 8): the embryo's cells undergo cell division at a rapid rate and begin to differentiate into body systems. It is when the developing embryo is more susceptible to toxic exposure (alcohol, drugs, infections, etc.). At the end of this stage, the developing organism is called a fetus.

- **Fetal period** (weeks 9 to 40): the fetus has its basic form and all major organs or tissues are already formed, but they continue to grow and develop.

The human body: reproduction

Fertilization, pregnancy and birth



Prenatal development in months 1 (fetus measures 4 mm and weighs 1 g), 3 (fetus measures 10 cm and weighs 45 g), 6 (fetus measures 25 cm and weighs 1 kg) and 9 (fetus measures 50 cm and weighs approximately 3 kg).

The human body: reproduction

Fertilization, pregnancy and birth

During pregnancy, women experience significant ***physiological, morphological and metabolic changes*** designed to protect, nurture and allow the development of the new individual.

- **First trimester:** Implantation of the embryo in the uterus. In the second month all the organs are already formed and some begin to work. The head grows faster than the rest of the body. In the third month, the developing organism is called fetus.
- **Second trimester:** The woman's abdomen will expand due to the expansion of the uterus. The size of her breasts will increase she will feel the fetus's movements. All the fetus' organs are already developed and the fetus keeps growing.
- **Third trimester:** The uterus reaches its maximum expansion. The fetus' organs finish maturing. The fetus changes its position to a head-first presentation. The fetus would be viable and could survive if it is born at the seventh month.

The human body: reproduction

Fertilization, pregnancy and birth

Pregnancy ends with **birth** (a.k.a. ***labor*** or ***delivery***), which consists in the baby leaving the woman's uterus by **vaginal passage** or by **C-section** (a surgical incision is made through the abdomen and uterus to deliver the baby). The stages of vaginal birth are:

- **Dilation:** the entrance to the uterus (***cervix***) dilates to allow the baby to leave the uterus through the vagina. Uterine ***contractions*** become more frequent and intense. The ***amniotic sac*** which encloses the baby ruptures. The duration of this stage is variable.
- **Birth** (or ***delivery***): the baby leaves the uterus through the vagina. The baby's umbilical cord is clamped and cut (its scar is the ***navel*** or ***belly button***). This stage usually lasts less than 2 hours.
- **Umbilical cord and placenta expulsion:** the ***umbilical cord*** and the ***placenta*** are expelled about 15 - 30 minutes after the baby's birth.
- **Postpartum:** period of 6 - 8 weeks after the birth of a child in which the woman's body returns to a non-pregnant state and the newborn adjusts to life outside the mother's body.